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Surveys Through
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November 1979

Final Report

Vol. IV Computer Processing Support

by J. L. Kast, L. A. Kraemer, B. M. Shelley, S. K. Schwingendorf and
T. L. Phillips

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FINAL REPORT
VOL. IV COMPUTER PROCESSING SUPPORT

BY

J.L. Kast, L.A. Kraemer, B.M. Shelley, S.K. Schwingendorf, T.L. Phillips

The research reported here was initiated during the planning phases of the AgRISTARS Supporting Research Project and, although it stands on its own merit, it benefits the Supporting Research Project and became a part of those plans.

Purdue University
Laboratory for Applications of Remote Sensing
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November 1979

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A. COMPUTER PROCESSING SUPPORT*

James Kast, Luke Kraemer, Bill Shelley,
Susan Schwingendorf and Terry Phillips

1. Introduction

1.1 Background

For the past twenty months, researchers at Purdue and Johnson Space Center has shared the Laboratory for Applications of Remote Sensing (LARS) computer facility as their primary data processing environment for research. The Computer Processing Support Task enables and supports this activity by:

- *providing access to a computer facility designed and implemented to support remote sensing research needs;
- *providing training in the use of the hardware and software facilities on the computer system;
- *providing consulting support to the remote users of the facility;
- *developing software supporting and enhancing the utility of the facility;
- *investigating, and promoting the potential benefits which may be derived when geographically dispersed research centers working on the same problem (researching remote sensing of agriculture) share a computational environment.

*The work conducted under 3A, Computer Processing Support Task, is the product of a team effort at Purdue and JSC. Creating the environment needed to enable a large, moderately diverse set of users at JSC to receive responsive computer service from an installation 1100 mile distant (at Purdue) is a substantial task. I believe JSC and Purdue have been largely successful in sharing the LARS computational facility through some very hard work by people at both institutions.

At JSC, I thank Ken Baker for his tireless collection and communication of user needs and his excellent representation of research computer requirements from JSC's perspective. His many hours on the phone with me and others at LARS has greatly magnified our ability to provide good computer service.

1.2 Objectives

The objective of the Computer Processing Support Task is to provide JSC and its associated research community with the environment necessary for the implementation of a shared data processing system for researching remote sensing of agriculture.

The full implementation of a shared data processing environment (network or centralized facility) would provide the following potential benefits:

- *the opportunity to better mold geographically-dispersed research groups into a more informed and integrated research team;
- *A mechanism for efficient transfer of information between research centers, NASA, and other participating government agencies;
- *Faster, less redundant software development;
- *Faster transfer of newly developed analysis techniques and research results to and from participating research groups;
- *Concentration of systems programming, data acquisition, data base and certain computer services at a small number of locations (frequently one).

These potential benefits can accrue largely through the communication features accessible to all users of a shared system; the elimination of the need to re-program techniques to be compatible with several different operating systems, data storage schemes, etc.; and the commonality of available software utilities, operational procedures, data, etc.

*Glen Prow of LEC has provided excellent hardware support, isolating and identifying problems in the communications hardware, training operations personnel, and suggesting and upgrading the JSC-LARS terminal system. Without his able assistance, JSC users might well be experiencing much more frequent down time on antiquated equipment.

Pat Aucoin, Mike Pore and Don McGee have provided local user support and Don collated and communicated resource request allocations for JSC users. Pat has also enabled researchers at Purdue to make more complete use of EOD LARSYS by enhancing its ability to handle LARSYS Version III formats.

1.3 Approach

The Computer Processing Support Task has a very broad scope. The discussion of Subtask is organized under the headings of Hardware Components; Software Support; Data Management; System Access; Communications, Consulting and Training; and Administration.

Over the past year, work funded through this task has consumed roughly half the computer time provided by LARS. Consequently the wants and needs of users sponsored under Task 3A have received attention. Special support responsibilities have been assigned to the computer systems and the systems analysis groups within LARS Systems Services.

In order for a promising new analysis technique to be shared, within the research community, recipients of the new technique must have:

- *Access to the software supporting the technique;
- *Access to hardware which supports the software;
- *Access to the data required by the technique;
- *A technical understanding of the technique; and
- *Knowledge of how to operationally use the software implementation.

To build a suitable environment for the implementation, evaluation and exchange of remote sensing data processing techniques, Purdue has concentrated its efforts on providing access to suitable hardware, software utilities and data. Purdue has also provided consulting and training support to foster user knowledge of the hardware, software and

*At Purdue, Ross Garmoe has supplied excellent basic systems support. Ross has been responsible for the design of the "TROUBLE" reporting system, the "MAIL" facility and the re-design of the Batch system. He contributed extensively to the installation of the IBM 3031.

Mon Li Tang and Peter Jobusch installed VS1 and CSMP under VM on the LARS system. Peter also helped convert and install Release 8 of SPSS and the new CMS version of SAS. Mon Li made the systems changes necessary to install the 1200 baud capability for the statistical multiplexor and Trendwriter terminals at JSC.

data facilities which are available on the shared system. The means for transferring technical understanding of fruitful new techniques and their software implementations are the joint responsibilities of the technique developer, the intended recipient of the technique and the sponsor. We are in the process of investigating means of technique transfers which may be enhanced through use of the shared system.

*Mary Ellen Pierson has been responsible for the JSC user disk backup system, generation of the User Group Accounting Reports, and handling the resource request system with Mike Collins.

Luke Kraemer has been responsible for the design, creation, maintenance and upgrades of the RT&E data base system.

Sue Schwingendorf has managed the preparation of CMS short courses at JSC for February and December of 1979. She has also maintained the IMSL package, the SRTNEWS facilities, and Task 3A input to Scanlines.

Bill Shelley has concentrated on visiting consultant activities and on certain software support activities. Bill has been responsible for adding universal format capability to LARSYS Version 3. He has been responsible for the software products areas which support LARSPEC, LARSYS, SPSS and SAS. Bill has also managed the upgrade of NSECHO and GRPSAM.

I thank Terry Phillips for his support, instruction, consultation and guidance.

The efforts of Tom Wilson, John Dolan, Jeff Rogers, Mike Luttrell, Doug Forehand and Joe Whalen are also gratefully acknowledged.

A very special thanks to Ruth Jarret, Katie Wolford, and Diana Dexter for their secretarial support.

2. Hardware Components

Several major computer hardware alterations occurred during the present contract year. These changes were necessary to satisfactorily support the expanded demand placed on the computational resources at LARS by the user communities at LARS and JSC. The most notable change was the replacement of the IBM 370/148 at LARS with an IBM 3031 machine. Disk space was also greatly increased to accommodate the expanding RTE data base at Purdue and the growing needs of the user community at JSC. Figures 1 and 2 present the LARS computer configurations as of 12/1/78 and 12/1/79.

There were also several communications hardware changes enhancing the accessibility of the shared data processing environment for JSC and ERIM. These changes will be discussed in System Access section of this report.

2.1 370/148 Saturation

Hardware is the backbone which computer facilities are built around. Any particular hardware configuration can support only so much computation.

For the typical job mix experienced between 6/78 and 8/79, the IBM System 370, Model 148 at Purdue/LARS provided a satisfactory research computing environment when:

- *The hourly average CPU utilization was at or below 60%
- *The ratio of total working set size to available memory was below 1.5:1.

However, during this period, we experienced frequent saturation of the day and evening shifts:

- *Afternoon working set to available memory ratios from 2:1 to 7:1.
- *As much as 40% of the available CPU cycles consumed in paging and overhead.
- *People waiting for the computer (extremely slow response times).

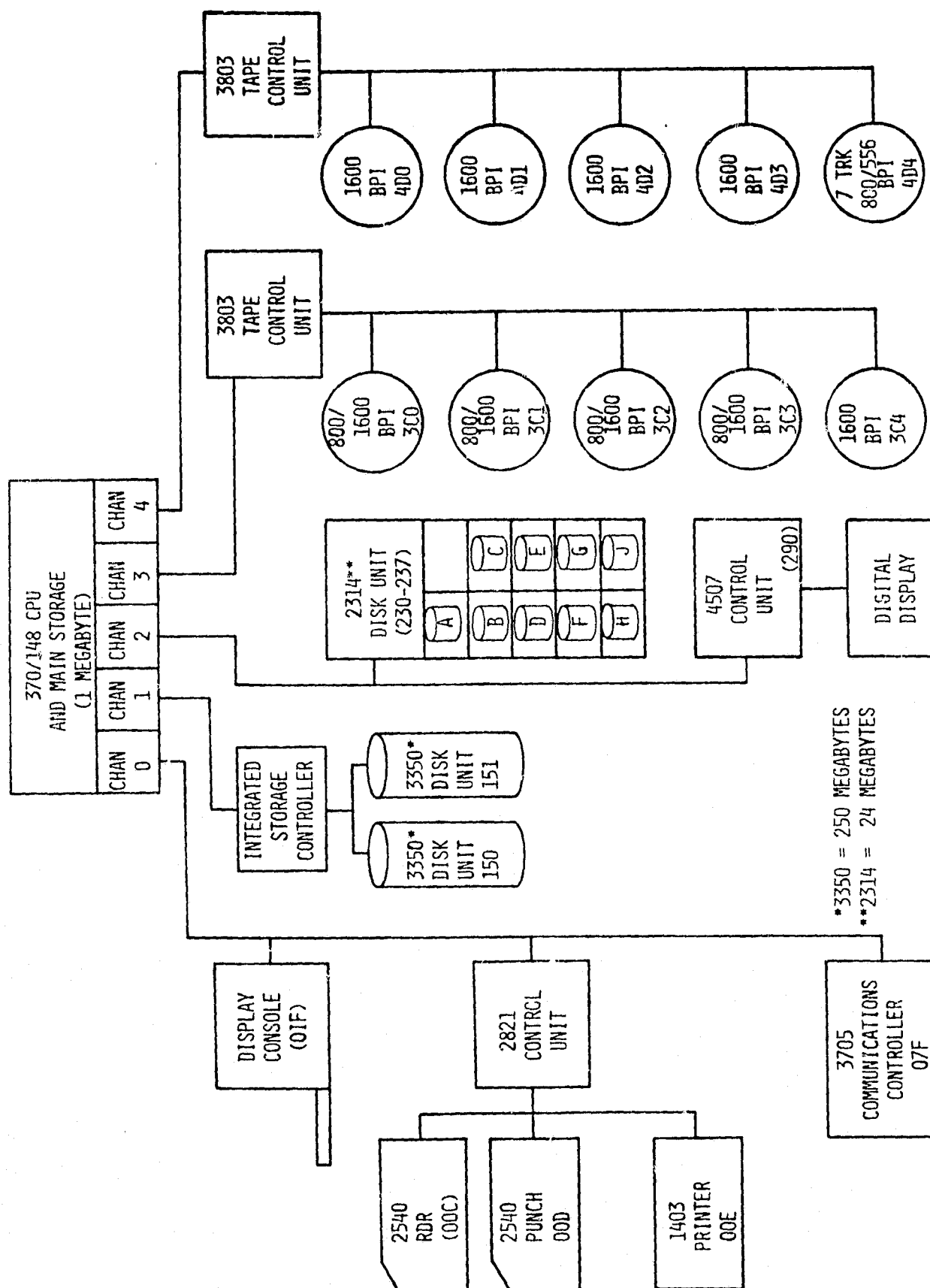
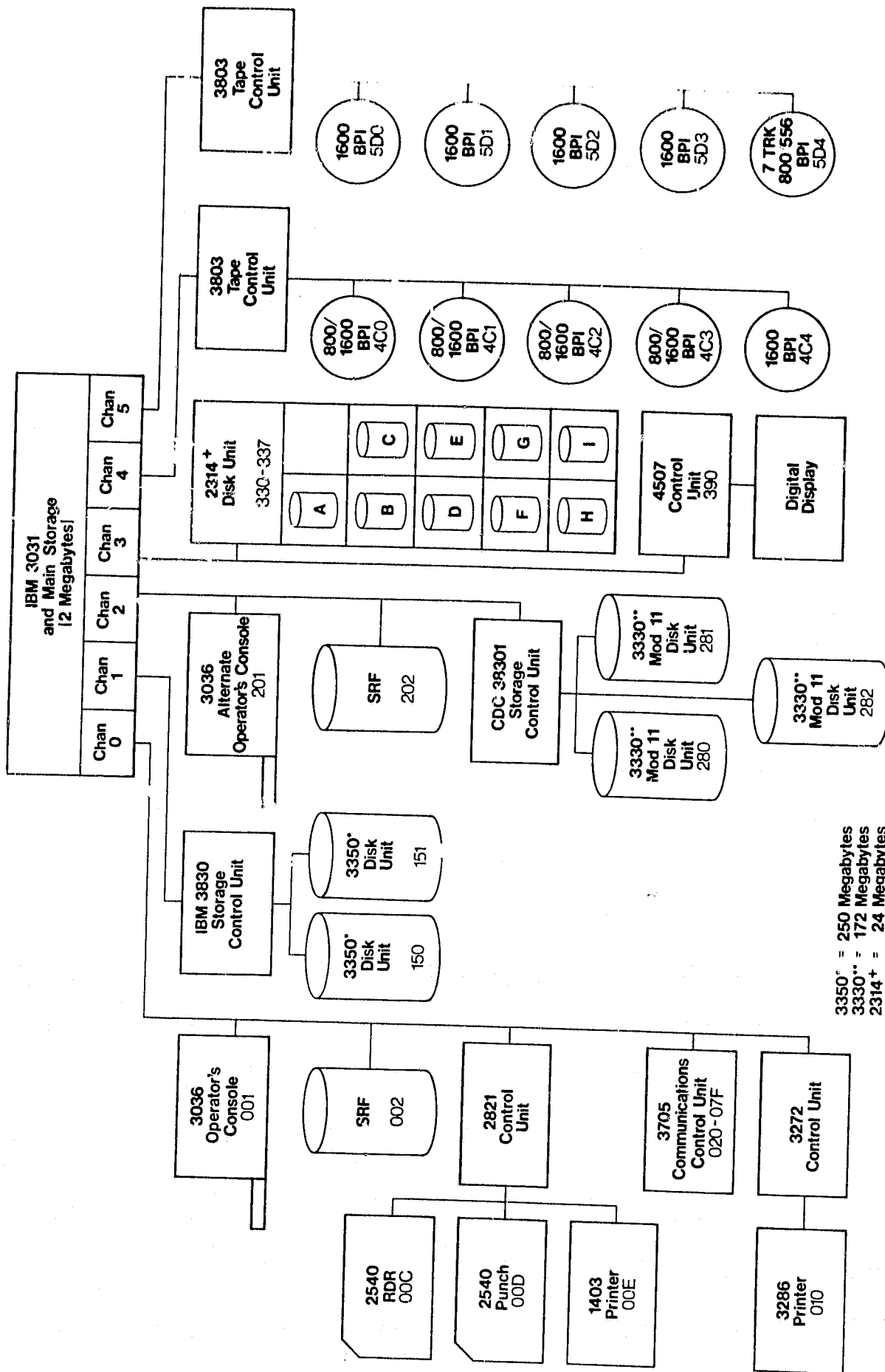


FIGURE 1

PURDUE/LARS COMPUTER CONFIGURATION AS OF 12/1/78

3031 Hardware Configuration



3350* = 250 Megabytes
 3330** = 172 Megabytes
 2314+ = 24 Megabytes

FIGURE 2

PURDUE/LARS COMPUTER CONFIGURATION AS OF 12/1/79

LARS responded by attempting to more evenly distribute the computer load through the day, by encouraging more efficient use of the computer, by investigating system bottlenecks and by investigating hardware alternatives.

More even distribution of the computer load was encouraged through:

- *Training and verbal encouragement for use of the batch machines which ran during mid-night to 8am (third shift).
- *"Free" third shift time for people to gain experience with and identify problems with third shift use.
- *Requests for user input concerning the utility of the batch machines and any specific upgrade suggestions.
- *Investigation of measures of "overhead" charged to users during peak usage periods.
- *An adjustment of rates encouraging midnight to 8am batch usage.

More efficient computer usage had been promoted through:

- *Acquisition of the Fortran II Optimizing Computer
- *Publication and presentation of guidelines for efficient computer use and programming.

System bottlenecks were examined through:

- *Acquisition of IBM's Virtual Machine Facility/370 (VM370) Performance Monitor Analysis System (VMAP).
- *Examination of computer queuing characteristics encountered under peak usage mixes.
- *Examination of paging and spooling characteristics of our system configuration.
- *Consultation with IBM systems engineers.

When these actions failed to impact the day and evening shift saturation problems, hardware alternatives were investigated and the decision was reached to pursue acquisition of a IBM 3031.

2.2 3031 Acquisition Plan

The decision to acquire a 3031 was reached in order to:

- *Allow a larger volume of highly interactive processing to be done during the day and evening shifts. This would result in a more productive use of personnel who were constantly waiting for the machine to respond to their interactive commands during the saturated day shift.
- *Provide more computational power per dollar. Although the rental of a 3031 would raise the cost of the LARS System Services by 10 percent, the 3031 was expected to be 2.25 times as powerful as the 370/148. Since machine availability was the limiting factor, the additional computer power was expected to be partially consumed, allowing a lower effective rate.
- *Provide a more reliable operating environment. The 3031 utilized somewhat newer computer technology and was equipped with backup and debugging features not available on the 148.
- *Make possible the consideration of additional projects or expansion of current projects requiring computer resources. The saturated status of the 148 precluded any meaningful expansion in total throughput on that machine.

Figure 3 presents a comparison of selected 3031 and 370/148 characteristics. In general, not only was the 3031 more powerful than the 370/148, but it has characteristics (outboard channel logic, more channels, more memory, high speed buffering, etc.) which are more suited to the type of interactive, I/O and CPU intensive research work performed on our system.

COMPARISON OF SELECTED CHARACTERISTICS

| | IBM 370/148 | IBM 3031 |
|-------------------------|--------------------------|----------|
| General: | | |
| Instruction Set | Equivalent | |
| Assist Packages | Equivalent Except OS/DOS | |
| Machine Cycle Time | 180 - 270 ns | 116 ns |
| Channels | 5 | 6 |
| "Cycle Stealing" | Yes | No |
| Dial-in-Servicing | No | Yes |
| Storage: | | |
| Size | 1M | 2M |
| Maximum Size | 2M | 6M |
| HIGH SPEED Buffer | None | 32K |
| 4-byte fetch | N/A | 230 ns |
| Fetch 8 bytes (Storage) | 810 ns | 805 ns |
| Store 8 bytes | 1080 ns | 345 ns |

Figure 3

Appendix A is the tasking document followed to achieve the successful implementation of the 3031 at LARS. The anticipated impacts of the 3031 installation were expected to be:

- *A 2.0 to 2.5 increase in throughput capacity.
- *More efficient computer users after installation due to greatly improved response time.
- *No major applications software conversions.
- *Capacity for additional computer projects.
- *Minimal down-time during switchover.
- *A need to secure continued funding for the LARS computer at FY79 level.

It was the funding issue which was the most sensitive at both Purdue and JSC. JSC could offer no positive guarantee that funding would be available to continue to support LARS at the FY79 level, but stated that the need for LARS computer service was there and that we were making a reasonable request. After reviewing JSC's response in detail, and the benefits to be derived from the 3031, Purdue elected to acquire the new machine without a funding guarantee from JSC.

2.3 Benchmark Testing

To insure that no major applications software alterations would be required, to obtain relative performance measures of the 3031 and 370/148 and to allow rates to be established on certain LARS software products, benchmark tests were designed and conducted at LARS and on a 3031 at an IBM installation at Gaithersburg, Maryland. A number of important pieces of JSC software were included in this test. Personnel from NASA, IBM, and LEC helped construct and validate software for the benchmark test. Specifically the following were included:

| | |
|--------------------------------------|----------------------|
| LARSYS | GLM ANOVA |
| IMSL | Landsat Reformatting |
| SPSS | Geometric Correction |
| EODLARSYS | BATCH |
| LARSYS P2 | RSCS |
| LARSPEC | FORTTRAN G |
| Yield Modelling's Law of the Minimum | FORTTRAN H |
| CLASSY | EDIT |

A representative of the JSC user community was present in Maryland to help support the testing on the 3031. The communications link was also validated on the 3031 by transmitting and receiving data to and from Gaithersburg and the Data 100 at JSC.

The results of the benchmark test indicated that a 2.9:1 improvement in throughput could be expected from a 3031 for the operating system and program mix normally experienced on the LARS facility. This result was surprising, being above the 2.25:1 which we had seen published.

2.4 3031 Installation

The 3031 was shipped on August 24 and arrived at Purdue August 29. By September 5 the 3031 components had been set in position in the LARS computer room, diagnostics run on the new components and certain minor hardware problems identified and eliminated. The 148 was disconnected at 6 pm on Thursday, September 6. Peripheral devices were uncabled from the 148, cabled to the 3031 and verified. The Benchmarks run at Gaithersburg

were then rerun at Purdue and the operators received hands-on instruction on the 3031.

The 3031 was up and ready for general use Monday, September 10 at 8 am, one day ahead of schedule. Benchmarks run on the machine installed at Purdue verified the roughly 3:1 improvement in performance. For further discussion of relative performance of the 148 and 3031, see Appendix B.

2.5 Disk Storage Space

During the second and third quarters, three IBM 3330 compatible disk units were installed. These units provided storage space needed by the SR&T data base, CSMP and the expanded needs of the JSC user community. In July the third 3330-compatible drive was installed to provide users of the 2314 drives a place to migrate as the 2314's were phased out. The 2314's have become obsolete and more expensive to maintain than newer, more reliable drives are to rent and maintain. The 2314's will be removed completely from the Purdue facility during January of 1980. No additional disk space acquisitions are anticipated in the near future.

3. Software Development

During the past contract year the accomplishments in software development maintained a good balance between work on planned tasks and responsiveness to immediate user needs. In providing software services, this balance must be carefully maintained in order to avoid either being entirely reactionary with no overall plan to provide direction or having work planned in such detail that resources are not available to react to user needs. Figure 4 lists the software which has been implemented on the LARS computer.

3.1 Systems Software

An online problem reporting system was developed. Its purpose is to collect information about any problems encountered by users, at the time the user discovers a problem. To make a report, a user simply types 'TROUBLE' as a CMS command. The rest of the process is self-explanatory.

A mail system was implemented to facilitate sending short message-type files to other system users, provide automatic notification that mail is being held for a user, and provide quick easy delivery of these files. Mail may also be sent to users who are not currently logged on. Mail is sent by typing 'MAIL userid fileid', where userid is the ID of the person who is to receive the mail, and fileid is the filename and filemode of the file to be sent. A user wishing to know if mail has been sent to his ID, simply types 'MAIL'. If he has mail, it will be displayed on his terminal; if not, he will receive a message stating that he has received no new mail.

Timelimit software was developed for interactive users. 'TIMELIMIT' is a command users may type during an interactive terminal session to set a CPU time limit for one or more succeeding jobs. The time limit is not job-specific, and will abend the user's job when time expires. Parameters may be typed on the same line as the TIMELIMIT command, or the program will prompt the user for information. Once set, the time limit may be queried, cancelled or changed at any time.

SOFTWARE AVAILABLE ON THE LARS COMPUTER

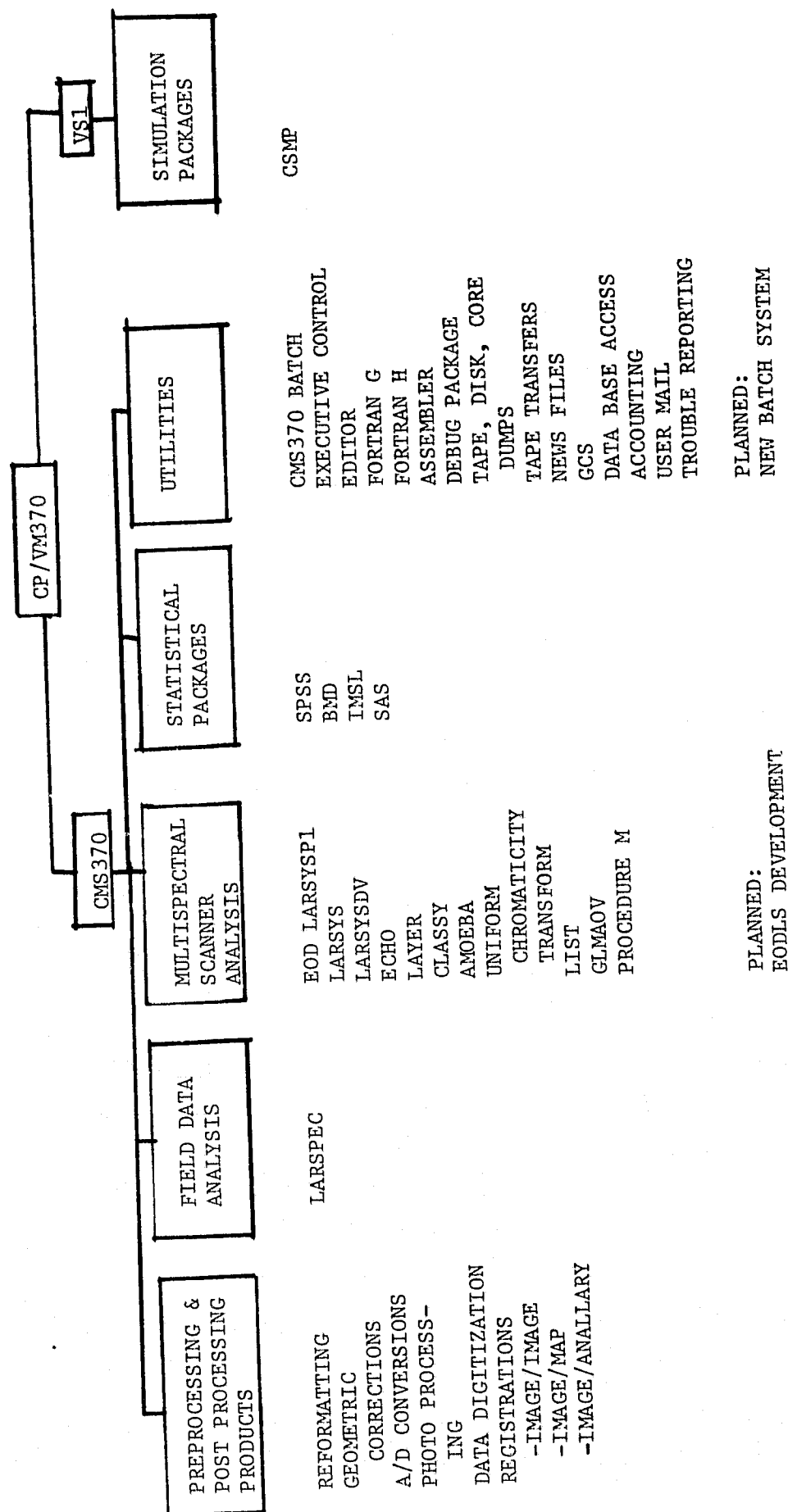


FIGURE 4

The SRTNEWS facility was updated to allow users to specify multiple output copies if the print parameter is specified, and to reduce the number of pages required to print the set of current news items.

Nine subroutines were added to the FORTRAN H TXTLIB (FORTMOD2). Eight of these, DEFINE, RENAME, REREAD, ERASE, DSDSET, LOGDSK, GETPAR, and TAPSET, were previously available for use with FORTRAN G. The other, DASDFI, is a new routine for issuing filedefs for disk data sets from within a FORTRAN program.

3.2 Statistical Software

Purdue/LARS now has a statistical consultant to assist users in the use of SPSS and other available statistical routines. Development or conversion of special purpose statistical programs may also be requested. New releases of SPSS will be installed as they become available. If a user encounters a problem of a statistical nature, he may contact Carol Jobusch at LARS.

Due to delays in the schedule for SPSS to provide a working CMS version of release 8, LARS acquired the source code for release 8 and developed an overlay structure necessary for installation.

Edition 7 of IMSL was installed on the LARS computer. As part of the revisions, 140 subroutines and entry points were renamed.

SAS, the Statistical Analysis System, is now available on the LARS computer under CMS. It provides a wide range of statistical procedures, a variety of plot and chart routines, data management tools, ability to read complex files, and extensive report-writing capabilities.

3.3 Analysis Software

Work was done on a data analysis procedure which is like Procedure 1 in philosophy, but incorporates local spatial information in both clustering and classification phases. The use of spatial information is achieved through use of an algorithm for Extraction and Classification of Homogeneous Objects (ECHO). An unsupervised form of this algorithm is used in clustering; a supervised version accomplishes the classification. The compatibility of these two processors overcomes one of the observed shortcomings of the present Procedure 1 (viz., fundamental incompatibility of the Procedure 1 cluster and classification algorithms). The proposed procedure is being implemented in five separate computer programs, in order to make maximum use of software already implemented.

Several enhancements to EODLARSYS were suggested. Among them were, the capability to use 800 bpi tapes, to have the data tape number appear on the output, and corrections to the LARSYS format output by DATA MERGE.

Four new computer programs have been developed at LARS to allow communication between Purdue's LARSYS and JSC's EODLARSYS analysis systems. These programs convert a statistics deck or a results file produced by one system into a format which can be read and used by the other. To further insure compatibility, the LARSYS software has been modified to allow for Universally formatted data input.

The LARS Spectral Analysis System (LARSPEC) was converted to run under CMS370. It was also modified to facilitate directly submitting LARSPEC batch jobs. Additional keys were also implemented for searching the spectral data base.

Operation of the tape transfer software (TAPTRAN) has been running smoothly. To further the capability a procedure was developed for transmitting improperly terminated tapes.

3.4 Resource Management Software

Software was implemented to provide additional accounting information on the 3A contract beyond what is normally provided. This allows the information to be broken down by user group. This report is produced weekly. Currently it is being modified to provide month-to-date entries and charges for software products.

In response to disk hardware failures, software was developed to automatically back up 3A mini disks to tape. To minimize the risk of loss of work, this is currently being done twice weekly. In addition, the entire LARS disk system is backed up once weekly.

To reduce the amount of confusion in requesting resources, software was developed to aid in this task. Now when resources are requested, such as a new ID or modifications to an existing one, records are automatically kept by the program as to when the request was made and when it was filled. Hardcopies of requests are sent to the operations group at LARS, the computer resources manager at JSC and the user when the request is entered into the system and when it is either filled or rejected.

The initial implementation of this system occurred during the third quarter. Several problems have been encountered with the software design, especially in the request entry procedure. A more elegant design is being pursued and will be reviewed and implemented during the coming year.

3.5 BATCH Enhancements

A new batch machine, BATHOUST, was added to allow users to run jobs requiring as much as 6 megabytes of memory. Jobs for this machine will be run at night with advance notice.

To aid the user in debugging batch jobs, a copy of the console output is generated and printed if an error is detected.

Additional output routing capabilities were added. In addition to being able to route the output to any site, the output may now alternatively be routed to a userid.

To aid the user in submitting batch jobs from a terminal, it is no longer necessary to use the NOHEADER option of the PUNCH command.

As part of the overall conversion from CMS 360 to CMS 370, all but one of the batch machines now operate under CMS370.

Currently, a re-design of the Batch System is being conducted. The goal of the redesign effort is to expand the users control over the batch system, reduce the amount of operator intervention required to control the batch job stream and to more efficiently utilize the collection of virtual machines supporting the batch processor.

3.6 Graphics Software

A 3-dimensional plotting tool that can be used in the development of analysis routines is now available. This new programming tool is the 3-D Graphics Compatibility System (GCS) obtained from the U.S. Army Corps Waterways Experiment Station. The USMA Graphics Compatability System is a FORTRAN based computer graphics system designed for use on a wide variety of computer graphics terminals. 3-D GCS is an upgraded version of 2-D GCS that has been available on the Purdue/LARS computer since May 1977.

Work is continuing on utilizing the graphics capabilities of DECwriter at LARS with the graphics board. Besides the typical plotting examples the DECwriter has also been used to plot information from the USGS county DIME file. The potential benefits of utilizing the graphics capabilities to display user specified components of the RT&E data base are being explored.

4. System Access

4.1 Communications Hardware Support.

2780 Replacement.

During the second quarter, the IBM 2780 at JSC was replaced by a second Data 100 with a tape transfer capability. The Data 100 functions as a HASP work station using HASP protocol. HASP protocol makes more efficient use of the communications lines between LARS and JSC, allowing more data transmission than 2780 protocol for any given baud rate. The 2780 at JSC had become somewhat unreliable due to its age. The Data 100 replacement has functioned well since its installation during the second quarter.

2740 Replacement.

During the first quarter, the two IBM 2741 Keyboard Terminals were replaced by Trendata terminals. The 2741's worked at 13.8 characters per second and required one of the four clocks which could be attached to the 3705 to support that unusual rate. When installed, the Trendata terminals functioned at 30 characters per second, and were upgradable to 120 characters per second. The elimination of the 2741's made it possible to replace the clock dedicated to them with a 1200 baud clock. This, in turn, made possible the installation of a statistical multiplexor and more efficient use of the band width dedicated to keyboard terminal communications.

Dial-up Modem Installation.

The Environmental Research Institute of Michigan (ERIM) had been accessing the LARS facility mainly to use LARSPEC and gain access to the field measurements data library. The utility of the system to ERIM was limited by the limited I/O available through a dial-up TI. ERIM utilized a COPE 1200 to access the MTS system through a dial-up 4800 baud modem. The COPE was utilizing HASP protocol; however, it did not support a punch, only a reader and printer. The RSCS software at Purdue refused to communicate with the COPE when it received the "device not ready" message for the COPE's punch. This problem was

resolved during the third quarter by revising the RSCS code. ERIM's COPE could then access LARS using their dial-up modem and the dial-up modem at LARS which is meant to accommodate the GODDARD installation. ERIM had to sign-on as Goddard, and several minutes of system staff intervention was required to redefine the protocol associated with the GODDARD PORT from 2780 to HASP.

During July, August and September, Purdue, ERIM, and the University of California at Berkeley (UCB) were investigating new ways of supplying JSC with research and development for the AgRISTARS project. At this time, it was agreed that use of the LARS computer for some development, all test, evaluation, and pilot work was the rational approach to the group's computer resource needs. We, therefore, pushed ahead with the installation of a dial-up modem dedicated to ERIM. This greatly reduced the effort involved in accessing LARS from ERIM. The expense of the long distance phone charges remains a concern of ERIM, however.

It is hoped that the cooperation and sharing of software and data which could have accrued from the AgRISTARS vertical slice, may still be realized to some extent without it. After a trial period ERIM's mode of access to the LARS system should be re-evaluated for its cost-effectiveness.

Statistical Multiplexor Installation.

During the fourth quarter, the 7200 baud modem for the Houston line was replaced with a 9600 baud modem, increasing the data transmission rate between Purdue and JSC. Shortly afterwards, a statistical multiplexor was installed and the two Trendata terminals at JSC upgraded to 120 character per second operation. The statistical multiplexor allows the device utilizing the modem to make maximal use of the available band-width upon demand, rather than dedicating a specific amount of band-width to each device.

Alternative Communication System Investigation.

One substantial cost of a remote terminal link is the charge for the communications line (long distance or dedicated line charge). We have been investigating the relative cost of the private network we now operate to those of telecommunication facility vendors, hoping to find a way to reduce leased line costs. The following vendors of telecommunications facilities have been contacted:

- Computer Sciences Corporation (INFONET)
- General Telephone (WATS)
- Graphnet Systems, Inc.
- MCI Telecommunications Corporation
- Southern Pacific Communications Company
- Telenet Communications Corporation (owned by GTE)
- Tymnet, Incorporated (owned by Tymshare)

Of these seven companies, only three have offerings of interest to us.

GTE can offer us in-WATS service on either a metered time (\$244 per month for the first 10 hours of use and \$18.31 per hour thereafter) or "full time" (1670 per month for the first 240 hours of use and \$4.65 per hour thereafter). In-WATS lines are provided as pairs in rotary. Their use would serve principally as an alternate means of funding long distance dial-up use for approximately the same cost as at present. (A one hour long distance call to Houston costs about \$20). Both asynchronous (teletype type terminals) and synchronous (2780/3780/HASP) traffic could be accommodated.

The other two alternatives are the Tymnet and Telenet packet switching networks. At present, neither can offer synchronous traffic support, although both companies intend to support it "in the near future". With either company, the cost to LARS would be approximately \$1500 per month plus \$1000 for installation of equipment to interface our computer with the network. In addition to this, those who access the network would pay for connect time and data transmitted. These charges range from \$5 to \$15 per connect hour and could be expected to total about \$7500 per month for our present traffic.

Until such time as our synchronous communications could be handled by one of these networks, no significant cost reductions to LARS and its user community are possible to offset the \$9000 monthly cost of the packet switch network. At that time, we plan to re-evaluate their cost effectiveness.

4.2 Usage Statistics

Usage statistics for the Computer Processing Support Project indicate the success of the shared system concept. The computer resources consumed for the year are nearly double those consumed during FY78 (See Figure 5). Figure 6 is a graph of the 370/148 equivalent CPU hour usage for the Computer Processing Support Task from December, 1977 to November, 1979. Not only was a large increase experienced during FY79 but 690 148-equivalent CPU hours were consumed during the August through November time frame -- that is a rate of 2070 148-equivalent CPU hours per year (roughly 700 3031 CPU hours per year). Coupled with the increase in usage at LARS, the decision to acquire the 3031 appears to be justified.

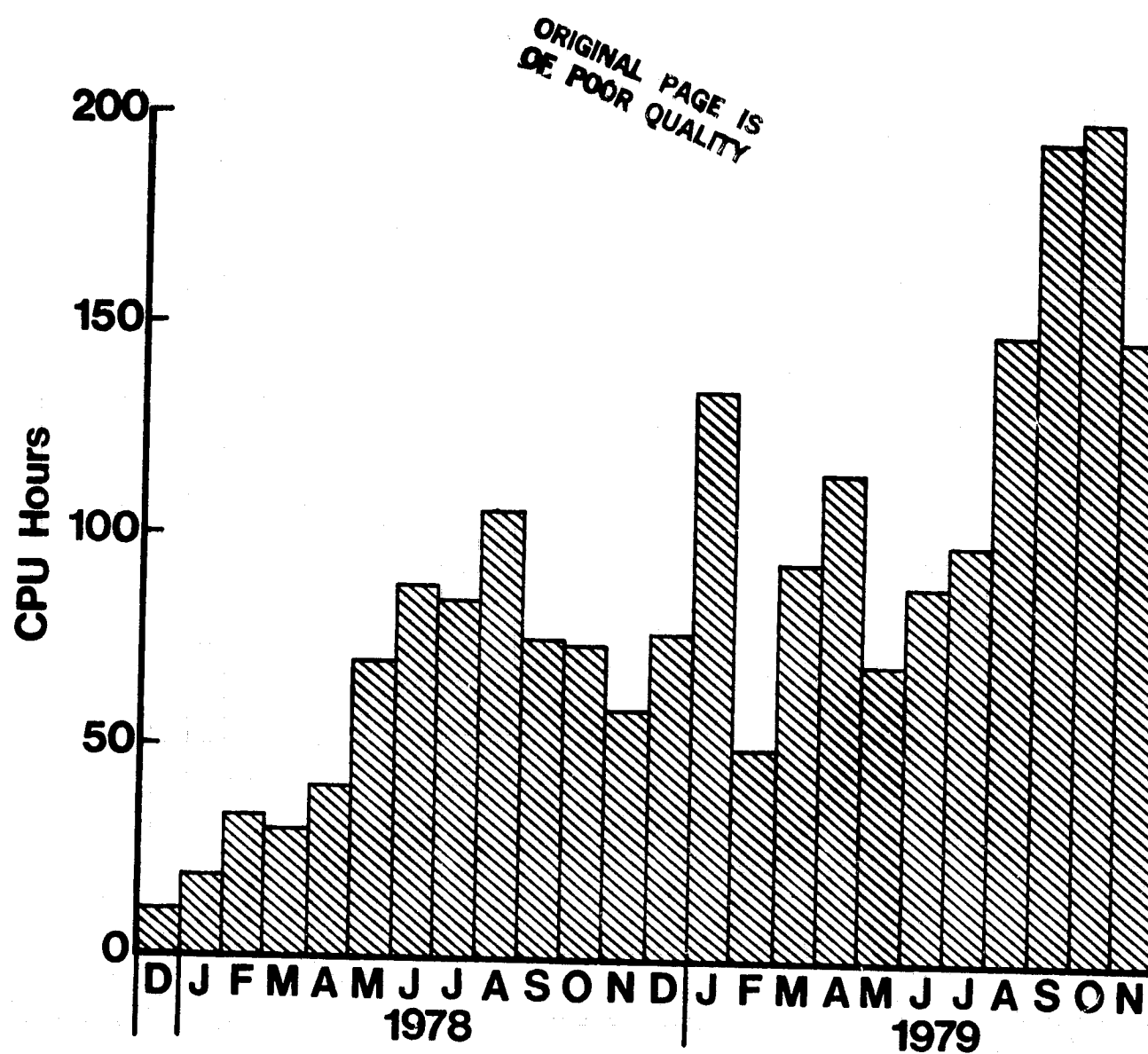
Figures 7 and 8 present the total CPU income usage on the 370/148 and 3031, respectively. The height of the graph at the lowest bar is the computer usage of the Computer Processing Support Task; at the second bar, the usage funded through the SR&T contract with JSC; and at the top bar, all income usage. Computer hours consumed by the LARS Systems Services are not shown on these graphs. System Services CPU hours constitute approximately 30 percent of the total usage.

These graphs clearly indicate the cost-effectiveness of sharing data processing facilities. The cost of a 370/148 based facility to LARS would have been 90 percent of the cost of a 3031 facility and would have been more than adequate for LARS computational needs. The 3031 facility increased computer power available to the JSC-Purdue user community three-fold, while increasing costs only 10 percent.

FIGURE 5
COMPUTER RESOURCES CONSUMED

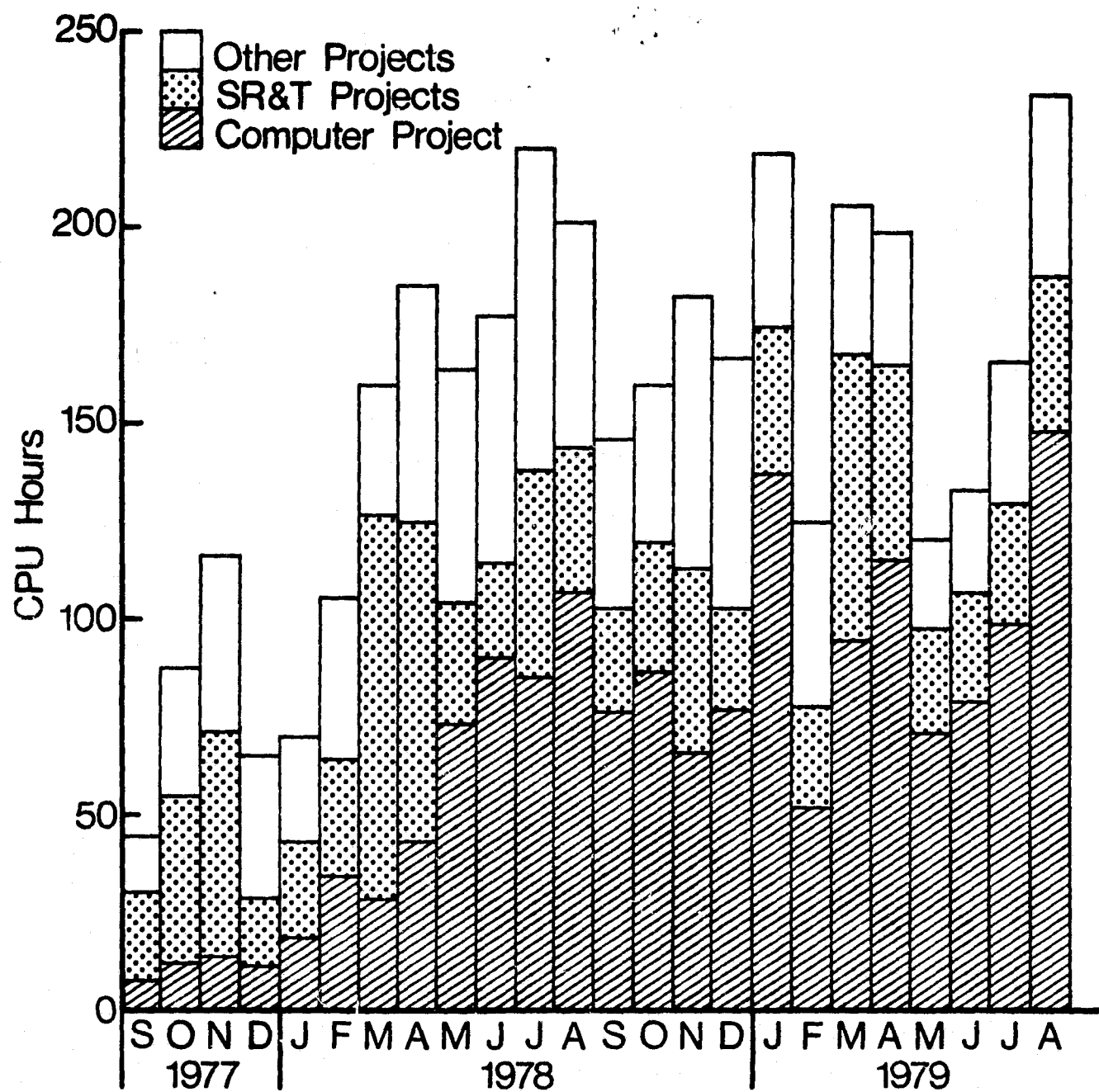
| | <u>Dec '77</u> | <u>Nov '78</u> | <u>Nov '79</u> |
|---------------------------------|----------------|----------------|----------------|
| JSC Users | 26 | 71 | 96 |
| LARS Support | 3 | 12 | 19 |
| Deleted ID's | | 8 | 3 |
| Batch Machines | | 3 | 4 |
| Library ID (JSC Disk) | <u> </u> | <u>1</u> | <u>1</u> |
| Total ID's | 29 | 95 | 123 |
| 370/148 CPU Hours, *year ending | 70 | 694 | 1374 |

*Equivalent 370/148 CPU hours. 3031 CPU hours are multiplied by three to approximate 370/148 hours.



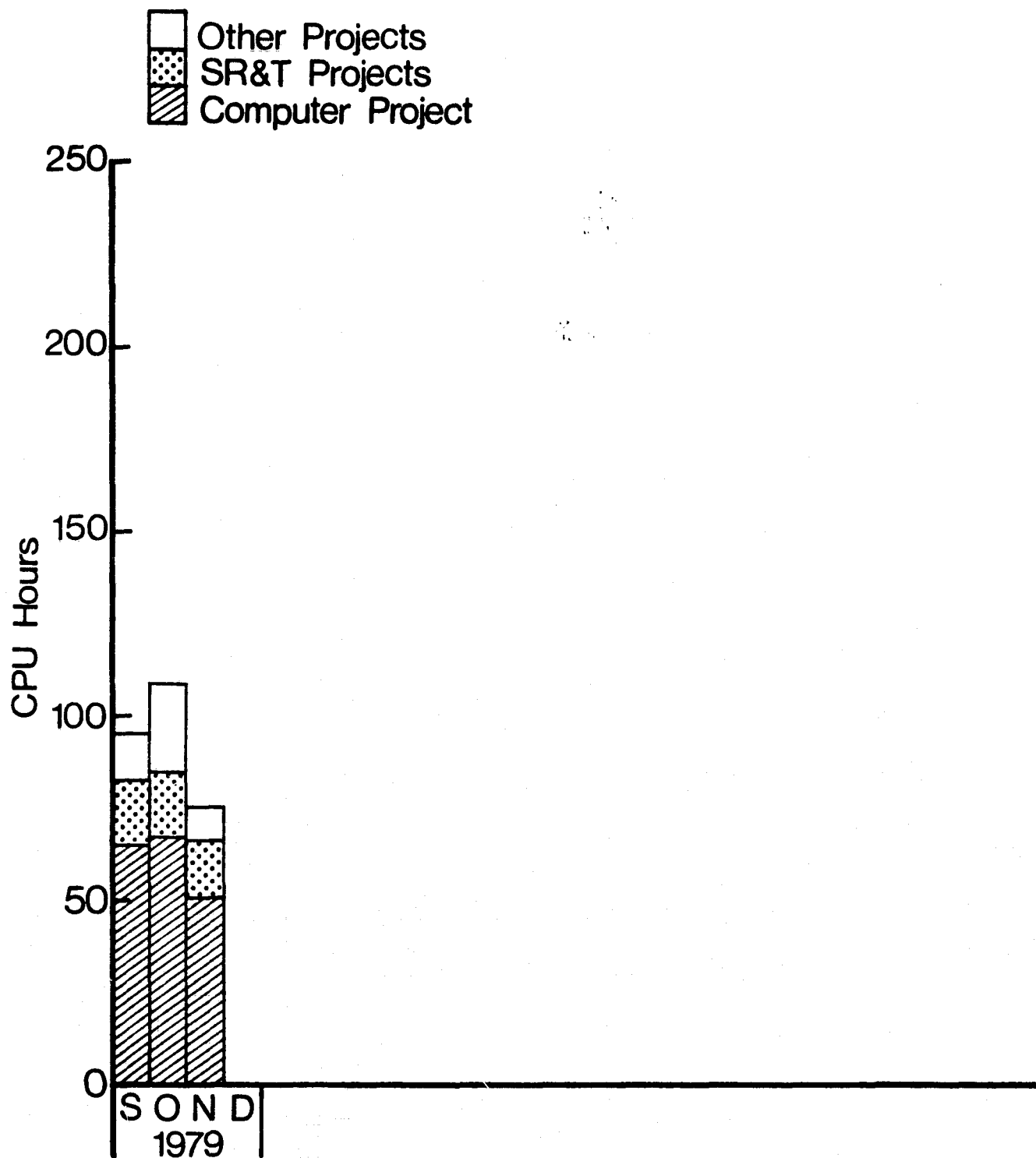
**Computer Processing Support
370/148-equivalent CPU Consumption**

FIGURE 6



Computer Use for Purdue 370/148
Total, SR&T Projects, Computer Project

FIGURE 7



Computer Use for Purdue 3031
Total, SR&T Projects, Computer Project

FIGURE 8

5. Data Base Management

5.1 Receive Data Bases

To support the research needs of the SR&T community over the past 18 months, the following data bases were acquired for the LARS computing system:

LACIE Phase I

LACIE Phase III Blind Site Ground Truth

Multicrop

Corrected Phase III Ground Truth

LACIE Transition Year Foreign Data Base

These data bases were loaded onto tapes in Building 30 of Johnson Space Center (JSC) and shipped to Purdue. Upon reaching Purdue, the tapes were inspected for data integrity, correct blocking factor, file organization, and readability. Following completion of these tests, it was found that a sizable proportion of the tapes were unusable. Copies of these tapes were re-transmitted to LARS and re-tested. This iterative process continued until a data base was complete and verified. The tape data base was then entered into the RT&E Segment Catalog and SUBSET data base. Users were notified of the installation through announcements in SRTNEWS and SCANLINES.

Obtaining a set of usable data base tapes proved to be quite time consuming during the beginning of the contract year. Quality control checks of the tapes being generated in Building 30 were insufficient. Discussions with JSC and LEC personnel concerning these tapes has resulted in a marked improvement in the reliability of delivered tapes. Further improvements in quality assurance should be expected as verification techniques improve.

5.2 Data Base Design & Implementation

Much of the data base work this year involved building, maintaining, and verifying the Segment Catalog. As complete data bases are received at Purdue, information pertinent to each Acquisition is retrieved and

stored in the RT&E Data Base. This process is a continuing effort which requires monitoring. During the past year, a complete data reliability test was run on the Segment Catalog. This verification not only assured data integrity, but also provided a check on the usability of some of the older LACIE data tapes.

An unexpected problem arose with the discovery that geographic locations associated with LACIE Segment Numbers are not always unique. Prior to that time, the Segment Catalog was organized with the Segment Number being the only master key. Since it was discovered that this arrangement could lead to geographic ambiguity, a new method of organization had to be devised. The latitude and longitude parameters were determined to be acceptable master keys to be included with the Site (Segment) number. This solution required a minimal expansion of the data base, minor software upgrades, and only a slight increase in data search time.

The current RT&E Segment Catalog stored at LARS contains over 43,000 Acquisitions. We expect to receive the LACIE Transition Year data for United States Sites soon. The receipt of this data set will expand the Data Base to over 55,000 Acquisitions. CMS file restrictions prevent any disk file from exceeding 65,536 records. Earlier this year, steps were taken to allow for the eventual growth of the Segment Catalog past the 65,536 record barrier. An additional Acquisition List File will be created to hold overflow data. The multiple acquisition files will form a single logical file. Links between the files will be maintained by two data items, referenced as the File Pointers, that have been added to all records in the Segment Index, Acquisition List, and Ground Observation Index. These pointers serve as flags to indicate which Acquisition File to read from next.

Efforts to reduce possible wasted memory and CPU time resulted in the implementation of a linked list of available (or free) Acquisition File records. The next free record is always pointed to by the second data item in the Next Node File.

During March, LARS obtained two IBM compatible, 3330 disk drives. Prior to this time, only portions of the Data Base were accessible to a user, due to a shortage of disk space. The 3330 drives provided freedom for growth and a significant decrease in data search time.

Development of data bases at LARS resulted in a dialogue between JSC, LEC, and LARS concerning the Big-Dot Ground Inventory System. A preliminary meeting took place in July and a technical discussion group met in October. Technical memorandums were also delivered to LARS personnel during this interval. LARS has agreed to implement the Big-Dot Data Base and work will begin in December.

5.3 Data Management Software

Software development has proceeded along two paths: creating new software products and upgrading existing software capabilities. New software designed, tested, and implemented by the LARS 3A Support team include programs to build the Ground Observation Index, a subroutine (GTINFO) to Query this ground truth data base, and a Segment Catalog Editor. This editor is a significant piece of software which aids in the maintenance of the data base. In order to maintain strict data control, the editor is only available to the Segment Catalog support personnel.

Activities to expand existing software capabilities include the easing of restrictions on the usage of some software and conversion of querying subroutines to FORTRAN-H. In early versions of data support subroutines SEGFO, GETACQ, GTINFO, and SUBSET, certain guidelines concerning disk access and logical unit definitions had to be adhered to. These restrictions have been lifted with minimal changes in the calling sequences. Conversion to FORTRAN-H had been hampered because of random access software problems which were not present in FORTRAN-G. The difficulties with the random access methods appeared to be related to the optimization performed at compilation. All routines have now been converted and work properly. All new changes and calling procedures will be formally announced during the LARS CMS Short Course

to be presented at JSC in December. Information on changes to the data support subroutines is contained in Appendix D.

5.4 Weather Data Base

During the first quarter, NOAA personnel contacted LARS concerning the possible development of a weather data base on the LARS computer. Preliminary data and software requirements were discussed. A weather data base system (Appendix E) was designed and these recommendations were delivered to NOAA. This design was reviewed with NOAA during the July LARS consulting trip. A NOAA data requirement meeting was attended during this trip. Software delivery dates and task allocation were also discussed. Final functional requirements were received at LARS in September. Weather data covering daily observations, monthly summaries, and snow fall were requested for the months of March, 1979 through June, 1979. This data was received in October. The data tapes were verified and entered into the LARS tape library.

6. Communications, Consulting and Training

This section deals with the personnel services portion of the Computer Processing Support Task. Training provides the background users require as a preamble to system use; consulting provides the expertise which helps to make users more efficient and effective; and communication is the glue which holds the "Support" portion of the task together.

6.1 Visiting Consultant Trips.

Problems encountered by remote users are frequently hard to fully understand or appreciate when described over the phone, especially when they require an understanding of the exact sequence of events, operating condition, etc. to diagnose. The immediate availability of an expert to answer questions and suggest approaches to software design and implementation is valuable. It is also extremely valuable to gain insight into a remote users operating environment and resource needs. For these reasons LARS supplies visiting consultants to JSC for three days to a week once every two or three months as requested. Visiting Consultant trips also afford those responsible for certain design or development tasks the opportunity to discuss these tasks with interested parties at JSC.

Bill Shelley served as a visiting consultant at JSC from May 7 to 11, 1979. He was able to provide general user consultation each day, present introductory lectures on the LARS computer system, meet with groups of people from NASA, LEC and IBM to consult on their use of the system, and discuss JSC testing contributions for the IBM 3031. Data base design recommendations were also discussed with NOAA representatives.

From July 16-50, Luke Kraemer was at JSC to provide general consulting on problems encountered by LARS computer users, to discuss the possible implementation of a weather data base on the Purdue/LARS computer, to show the graphics capabilities of a DECwriter terminal,

to review the procedures for requesting computer resources and to encourage checking the quality of computer tapes before they are transmitted (via the computer for mail) to LARS.

A two-day visit by Luke Kraemer and Peter Jobusch took place October 4-5. Besides providing general consultation for computer users, Luke and Peter attended discussions for future reference on how the data for LACIE was maintained and stored.

The final consulting trip for the contract year occurred the week of November 12-16. Bill Shelley and Mike Collins were available to provide general user consultations, and to discuss how Purdue can provide more responsive computer resource allocations for JSC users in the coming year.

6.2 General Consulting

Consulting support is by no means limited to visiting consultant trips. A user seeking advice, help, system error correction, etc., may use the telephone to call someone at LARS or choose to use the interactive "MAIL" or "TROUBLE" features. In addition, some consulting support is available at JSC. For example, Bob Goode is responsible for supplying computer resources (Computer ID's, tape ring in assignments, disk space, etc.) to JSC users. Bob should be contacted with any questions about computer resource requests. Figure 9 lists Purdue personnel who may be contacted with consulting questions.

6.3 Communications Study

During the second quarter a study of the communications problems associated with contacting and receiving information and support from systems services personnel was conducted. The objectives of this study were to identify what the overall responsiveness to user inquiries was, to identify which means of communication were important and effective, and which were not, and identify what users view as the primary communication problems with System Service personnel. The questionnaire

FIGURE 9
Consultant List

| | |
|--------------------|--|
| ROSS GARMOE | Systems Questions/Topics; the "MAIL", "TROUBLE", and "Batch" systems, RSCS problems |
| MON LI TANG | VS1 and CSMP problems |
| SUE SCHWINGENDORF | SRTNEWS, IMSL, Scanlines Input, CMS questions, CMS Short Course |
| LUKE KRAEMER | Data Base Contents, Access, Support Software, General CMS consulting |
| CAROL JOBUSCH | SAS, SPSS, Statistical Consulting |
| BILL SHELLEY | EOD-LARSYS IPL System, Tape Transfers, LARSPEC, GCS, LARSYS, LARSYS support sub- routines (MOUNT, TAPOP, etc.) |
| MARY ELLEN PIERSON | Operations Procedures, CPU credit, System Backup |
| JIM KAST | Administration, software development, new projects, any subjects covered above or not listed |

was distributed to three groups, the LARS Systems Service Personnel, System Service users at LARS, and System Services users obtaining computer service through the Computer Processing Support Task.

Figure 10 presents the overall responsiveness of the LARS Systems Services personnel to user problems, as rated by these three groups.

FIGURE 10
OVERALL RESPONSIVENESS

| | RESPONDENTS | NASA | SUPPORT CONTRACTORS | VERY GOOD | GOOD | ADEQUATE | NEEDS WORK | TOTALLY INADEQUATE |
|--------------------------|-------------|------|------------------------|--------------|------|----------|---------------|-----------------------|
| 3A Users | 16 | 10 | 6 | 7 | 6 | 2 | 0 | 1 |
| LARS Users | 15 | | | 4 | 7 | 2 | 2 | 0 |
| System Services Staff | 16 | | | 4 | 7 | 4 | 1 | 0 |
| TOTALS | 47 | | | 15 | 20 | 8 | 3 | 1 |

It should be noted that roughly three fourths of the respondents evaluated the overall response to user needs/problems as Good or Very Good. Interestingly, the overall rating given by the Houston users was even higher than that provided by users at Purdue.

The value of communication and information transfer media were viewed somewhat differently by local users at Purdue and the users at JSC. JSC users rated the effectiveness and importance of common means of communication as:

1. Personal Contact
2. Phones
3. Terminals
4. Scanlines
5. Memo
6. Correspondence
7. SRTNEWS, Documentation, Staff Meetings

SRTNEWS was a new feature at the time the questionnaire was developed and was listed as a write-in.

Among the major problem areas, there was again good evidence of overall satisfaction on the part of JSC users. Using a 3, 2, 1, 0 weighting for possible a list of communication problem areas, no problem area received a weighted average response as high as 1. Figure 11 presents the responses to the Problem Identification section of the questionnaire.

FIGURE 11
COMMUNICATION PROBLEM AREAS

| | VERY | SOME | LITTLE | NONE | WEIGHTED AVG. |
|--|------|------|--------|------|------------------|
| WEIGHT | 3 | 2 | 1 | 0 | |
| 1. Inability to contact person due to absence from desk. | 2 | 0 | 7 | 6 | .87 |
| 2. Information given is not adequate. | 0 | 4 | 2 | 8 | .71 |
| 3. Promises for services are made; then not kept. | 1 | 1 | 4 | 8 | .64 |
| 4. Misinformation is given. | 1 | 1 | 2 | 9 | .54 |

Write-in problems included:

- Don't know whom to contact should something go wrong.
- Long delays in placing long-distance calls.
- Too few people to interface with at JSC on a technical level.
- Inadequate IBM and LARS documentation available.
- System is slow and sluggish.
- Hard to get hold of part-time LARS Personnel.

A JSC request to the FTS to place an FTS line to LARS would probably reduce the delays in long distance calls, particularly calls made after the Indianapolis FTS office closes. Considering the volume of phone calls between Purdue and JSC, some real monetary savings might also result.

The installation of the 3031 has probably eliminated the comment about the sluggishness of the system - which is not really a communication problem anyway.

The level of expertise in use of the LARS computer has been rising at JSC. As it grows, the opportunities to interface with the elements of the JSC user community having a good technical knowledge of how to utilize the LARS facility, also increases.

In order to supply an input channel to users unable to contact the appropriate technical expert at LARS, the "TROUBLE" and "MAIL" interactive communication utilities have been developed. If a user wishes to report a problem he is having, he should simply type 'TROUBLE' on his terminal and follow the resulting instructions. His request will receive a response whether or not he knows the right person to contact or if that person is present. The MAIL system allows a user to send a memo to any ID, whether or not it is logged in at the time.

6.4 CMS370 Training Courses

During the week of February 5-9, 1979, a course on using the Purdue/LARS computer was presented at JSC by Susan Schwingendorf, Luke Kraemer, and Bill Shelley. The main topic of the course was the use of CMS, but sessions were also presented on the availability of other software.

Preparation is currently in progress for another CMS short course to be presented the week of December 10-14, 1979. Five instructors will be available at JSC during various portions of this week. They are Larry Biehl, Luke Kraemer, Peter Jobusch, Susan Schwingendorf, and Carol Jobusch. For this course, the topics have been divided into 19 one hour modules, with prerequisites defined for each module. The first two modules are designed for newcomers to the Purdue/LARS computer and/or CMS. Six modules cover material on intermediate level and deal with virtual machine concepts, CMS and Edit commands, beginning EXEC files, using BATCH and CMS commands for programmers. The remaining sessions cover more advanced aspects of the intermediate modules, or

deal with the availability and use of other software. Tape/slide presentations of the course material for each module are planned and will be sent to JSC upon their completion. Appendix F contains the course outline and schedule for both the February and December CMS short courses.

7. Administration

The purpose of this section is to provide background information on the organization, philosophy and policies of the LARS Systems Services. This information should help those utilizing LARS services better understand the environment from which the services flow. This information may also present a model of how computer resource expenses may equitably be charged against those projects consuming the resources. Such information may be of value to those planning the installation of a computational facility for remote sensing research within the Earth Observations Division.

Much of the material contained in this section is contained in the "LARS Systems Services Administrative Plan for Fiscal Year 1980".¹ The Administrative Plan is an internal document providing a detailed description of the LARS Systems Services; the philosophies, services, rate derivations, objectives, accounting system and approved rates.

7.1 Systems Services Background

Boundary Conditions.

LARS System Services was established in February 1975 as a self-supporting enterprise of Purdue University. The objective of LARS System Services is to provide specialized and unique services to the sponsored projects of the Laboratory for Applications of Remote Sensing (LARS) at Purdue University within the following boundary conditions:

*The enterprise will operate on a no-profit/no-loss basis at a minimum financial risk to Purdue University:

*The enterprise will provide services required by the LARS research community at acceptable levels of quality and quantity, and at cost effective rates.

¹ LARS Systems Services Administrative Plan for Fiscal Year 1980; T. L. Phillips, et. al., Internal Document of the Laboratory for Applications of Remote Sensing, Purdue University; July 1979.

*The enterprise must attract a demand for services at a level equal to the minimum base required for effective rates.

*The enterprise must provide a rate structure which offers uncomplicated alternatives from which the research community can plan resource needs.

Cash Balances.

Because LARS System Services is self-supporting, it must operate as near to a year-end balance of zero as possible. LARS has estimated that its ability to forecast the annual activity, thus income and expense budgets, is good to plus or minus 10 percent. However, applied to the operational level, we have found that the University is unwilling to let the cash balance drop to -10%. The philosophy of no negative cash balance then becomes an estimation error of 0 to +20%. That is to say, LARS System Services residual cash balance may be reasonably expected to fall between 0 and a positive 20% of that year's expenses. Any positive balance is carried into the next year and is counted as a contra-expense when new rates are calculated.

Costing and the Rate Structure.

LARS System Services is working under a costing concept. Part of condition 1 stated in section 7.1 is to offset expenses in any one year by income generated through a rate structure for the same year. However, because of the complexity of the income and expenditure budgets, it is likely at the end of any one year to have income greater or less than expenses. The University has indicated an acceptability of a positive 20% carry forward. This carry forward must be distributed among the products that produced it in the successive year to lower the rates (or to avoid increasing them if services are being increased). The distribution of this carry forward is made in July of the new fiscal year by the Deputy Director, based on data generated from the monthly reports.

In calculating the rates for products, every attempt is made to itemize all direct costs associated with each product. To properly identify these costs and to develop data for their analysis, departmental reference numbers are used to assign expenditures to each product. The identified direct costs are divided by an estimate of unit demand to derive the unit rate.

When trends toward excess income or expense are identified, attempts to reverse them will be made first by adjusting expenditures. Should this fail, rate adjustments may be required to regain balance. It should be noted that changes in the expenditure budget will normally be adequate because:

- a. If excess income is being generated it is likely that added demand should be met by adding resources. Note, however, when additional resources are not needed to meet additional demand, the rate should be lowered.
- b. If excess deficits are projected, it is likely that too much service is available, so expenses should be decreased. It may also be that not enough research personnel are demanding services. In this case, System Services personnel can be assigned to projects, thus increasing demand while decreasing costs.

It should be noted that because of the relatively inelastic demand and the limited funding available at any given time for sponsored projects, rate adjustments may not generate enough additional revenue to avoid a deficit.

LARS System Services does not attempt to recover "indirect" costs from users. Since all of the System Services users pay either indirect costs or administrative costs, it is inappropriate for LARS to make additional charges to the projects.

Establishment of Products (Services).

A key to the success of the costing concept employed in Systems Services is the identification of meaningful, identifiable, products which will have a sufficient volume of consumption and whose production costs can be appropriately modeled through rates. New products are usually conceived by one of the System Services managers who maintain close contact with user needs and program capabilities.

Before the product and its associated rate are established as part of the LARS product line, it is important to communicate the need, definition and estimated rate for the new product to personnel using or requiring the new product. For this reason, a procedure for establishing a new product has been developed.

The procedure for establishing a new product includes naming the new product and identifying it through a written description of the product including what it is, what can be expected from it, its availability, and the measure of service which will be charged for the product. A rate for the new product must be selected by examining the production process for the product, its estimated income, and the expenditures required to produce the product. Each expenditure must be listed along with a description of why it is required as a part of the product. The income and expenditure budgets are then used to summarize the development of the rate. Finally, the effect of the product on LARS System Services objectives is documented. This information is then presented to the System Services managers and program leaders for their input. Assuming a favorable response, the new product will be approved by the Deputy Director, and a formal request for the establishment of a new rate will be prepared by the LARS Business Administrator.

This year LARSPEC, LARSYS and Statistical Services were added as products under a new product category known as "Software Products". Previous to the creation of Software Products, maintenance of these software packages was charged to projects or underwritten by Computer and Priority Service through the rates charged for CPU time. Now if a user does not make use of one of these packages, he does not subsidize it.

7.2 Evaluation of the Computer Processing Support Task.

The Computer Processing Support Task has been beneficial to researchers at Purdue and JSC. This is evidenced by the near doubling of computer use at JSC; the reduction in the cost of computation for all users; the sharing of software and data by Purdue, NASA, IBM, LEC and to a much more limited extent ERIM personnel; and the creation and limited use of certain computer user communication facilities for LARS-JSC communication.

JSC Benefits.

The Computer Processing Task at LARS have served as a "pilot" for the concept of a shared SR&T computational environment. Such an environment could be supplied by a centralized computer system or through a network of computers. In one way or another JSC will:

- *Pay the bills for computer, personnel, and other expenses incurred by all the members of the JSC-sponsored research community.
- *Benefit from those fruitful new techniques which can successfully be integrated into Pilot and LSAT analysis system.

A shared computational environment potentially provides:

- *User access, at all user locations, to the data, software, and documentation contained in the shared environment,
- *Sharing of expensive portions of processing hardware at a cost advantage,
- *Sharing of software allowing flexibility in software maintenance, addition, and updating at a cost advantage over independent, non-compatible systems, and
- *Ease of training users and sharing and comparing new techniques through standard data formats, terminology, and shared communication channels.

The "pilot" shared data processing environment appears to be demonstrating many of these benefits. Users at JSC are making use of the field measurements data library and LARSPEC software at Purdue without:

- *having to copy, transport and verify a copy of the data base for JSC users;
- *convert the LARSPEC software to run on a different computer with a different operating system;
- *wait for the two items above to transpire;
- *support the updating of the JSC LARSPEC or field measurements data base each time it is updated at LARS; or
- *constantly running verification tests to insure the two implementations remain functionally equivalent.

Similar statements could be made of LARS' use of LARSYSPl and LARS' and JSC's use of SAS, SPSS, IMSL, LARSYS, the RT&E data base, SCMP, GCS, etc.

The acquisition of the 3031 is a good example of the potential hardware cost savings. To supply the computational power needed by the SF3 research efforts of NASA, Purdue, LEC and IBM costs only 10 percent more than a hardware facility needed to supply the computational needs of Purdue alone (the 370/148).

Several communication channels have been developed which utilize the shared environment. Included are the SRTNEWS facility, the MAIL facility, the TROUBLE error reporting service, and the computer resource request system. The commonality of computer environments has allowed a CMS short course to be developed and presented to users at both JSC and LARS and for a hands-on version of the LARS Monthly Short Course to be presented at JSC at a cost savings over the expense of transporting 15 NASA participants to Purdue.

The computer systems in Buildings 12 and 30 at JSC were not specifically designed to support remote sensing research and techniques development. The machine at LARS, on the other hand, was. The Virtual Machine operating system (VM/CMS370) on the LARS computer has several very useful features. Each user is treated as if he were the sole user

of a machine (hence virtual machine). This concept allows the definition of machine memory size, devices available to the machine, etc. It allows very interactive processing modes without greatly sacrificing computer throughput, processing user Y's job while waiting on input from interactive input by user X. Certain earth resources data processing functions strain the ability of a machine to perform complex computations; others, the ability to handle large, complex data sets; others the ability of human interaction with intermediate results; still others combinations of these capabilities. The LARS computer allows a number of users to simultaneously use the real computer; each user specifying the machine configuration which will best suit the characteristics of his job. Not only can the aggregate of user-defined system resources surpass those actually available on the real machine, but any single user might define his virtual machine to have resources superior to those of the real machine. This operating system made possible the research and implementation of geometric correction and registration processors on machine only a fraction of the size that would have been required had a more conventional operating system been employed.

The reaction of the JSC research community to availability of this system is best reflected by the constant increase in demand for computational resources by a user community of relatively stable size. (See Figure 6.)

LARS Benefits

While personnel and computer cost have been steadily rising over the last three years, funding for research work at Purdue has suffered a slight decline. Had JSC not been able to make significant use of the LARS computer, its continued existence would have been problematical. Without a computational facility much of the research work at Purdue would have been severely impacted. By using the LARS system to supply EOD computational support needs, Purdue's facility has been maintained.

The remainder of this section is composed of excerpts of the "Financial Analysis of Fiscal Year 1979" Appendix C of the "LARS Administrative Plan for Fiscal Year 1980." This Appendix was written by Terry L. Phillips.

During 1979, the LARS System Services has achieved many significant objectives. Most of these are reflected in the Financial Statement. Some of them are highlighted here to provide the reader with the significance of the financial analysis.

The first achievement of note is the sustained computer usage for the fiscal year. Eighteen hundred computer hours were projected for the year. Two thousand seven hundred thirty six hours were used. The hours were evenly distributed over the four quarters. This is the first year that we have had computer usage of over six hundred hours per quarter since 1973, and the first occasion of its happening since LARS System Services was started in February of 1975.

There are at least two reasons for the increase in computer use during the year. One is the continued activity by remote sensing specialists at NASA in Houston, which provides increased usage and closer communication between LARS and the principal sponsor of LARS. The second reason is the use of batch services by computer users. Batch service has been encouraged by a batch training experiment in October and November of 1978, and by increasing the Priority Service rate. The resultant use has allowed the decrease of the rate for all computer services.

The increased computer use led to the decision during the year to change computer systems. In September of 1979, the IBM 370/148 was retired in favor of an IBM 3031. The 3031 will increase the cost of computer services about 10%, and provide about three times the computer power.

The usefulness of the computer to people is also reflected in the attached time, or the time in which people are using the computer. These figures show the amount of attached time since the IBM 360/67 went into operation in 1971, and include the attached time for this fiscal year. The attached time first went over the 14,000 hour level in the last quarter of last year. In every quarter of this year, the attached time was greater than 14,000 hours and was almost 18,000 hours during the first quarter of fiscal year 1980.

Another significant event of this year was the creation of Software Products. Although these products lost money this year, their creation has increased support of important user software. It is expected that the increased support will increase usage and that the products will break even next year.

During this year, a significant study was made on additional equipment required to increase capability to Purdue researchers. The study resulted in a specific recommendation to purchase a color digital display and supporting equipment, and a recommendation to the Purdue Administration on a financial method of handling the purchase. These recommendations have been accepted, and it is expected that the equipment will be ordered next year.

Anyone following the financial status of LARS System Services is aware that in the past, the status has been oscillating quite rapidly. It appears that the financial status is becoming more stable. It may be too early to predict stability, but the graph of bimonthly cash balance clearly shows that the period between the ups and downs is increasing, and does have some tendencies toward stability.

These achievements, and others, are reflected in the financial analysis. The year-end annual financial reports for LARS System Services show that this past year is the first year we have had a positive balance since fiscal year 1976, and that the total activity is larger than any of the past years. It is significant that the amount of income obtained allowed greater expenditures in the personnel columns. These additional personnel approached levels that existed in fiscal year 1977, and have contributed greatly to our ability to provide quality services at a reasonable cost.

8. Recommendations

8.1 EOD Computer System Development

To meet the expanded computational needs placed on the NASA's Earth Observations Division (EOD) by the AgRISTARS project, EOD is pursuing the acquisition of a computer. This computer is not anticipated to be large enough to supply the computational of JSC's entire research community including the universities and ERIM. The following recommendations are made for this system:

- *It should be as compatible as possible with the system at Purdue/LARS. Compatibility will ease the transfer of software from the LARS to the EOD machine, reduce the need for retraining of JSC personnel, provide an environment of demonstrated value for research of remote sensing of agriculture and make possible the networking of the LARS and EOD machines. Additional consulting help would be available from LARS to aid EOD as it goes into the general purpose machine business. Also, the Purdue machine could be used for system development and test prior to the installation of the EOD machine.

- *It should be networked with the computer at LARS. In addition to maintaining the benefits of a shared computational environment which have been experienced by LARS and JSC for the past two years, networking makes possible access to software on either machine, overloan computing to be shared by both machines and backup computing in the event of failure of either machine.

- *Use of the network should be expanded to include all major research sites supporting EOD. In addition to reducing costs through reduced software development redundancy, reduced software conversion costs and reduction in the number of computer facilities EOD must support, it would also provide for a long term increase in productivity by reducing the time needed for technique transfers, making a fuller range of analysis capabilities available to all research sites, providing a mechanism for research-community-wide communication, and eliminating system differences as deterrents to understanding newly developed software techniques.

8.2 Establish a Research Community Baseline System.

New technique development and techniques exchange could be further speeded if a modular, baseline research system framework were developed which would accomodate most new software techniques developed in the research community. Such a system structure would allow analysis system components developed at different sites to be easily compared or combined into hybrid analysis systems without extensive re-programming. The development of such a system structure requires substantial thought, documentation, and communication, if it is to be successful. LARSYS Version III, LARSYSPI and QLINE are non-compatible examples of such a system concept. It is recommended that this system be implemented only after a joint NASA-Purdue-ERIM software design team has carefully examined alternatives.

8.3 Programming Conventions Documentation and New Techniques Delivery Standards.

In order to expedite technology transfer within the SR&T research community and between the research and the application communities, certain programming, documentation and software delivery standards should be established. One benefit of the modular baseline analysis system is that its framework will allow the addition or the replacement of analysis processors without requiring major system rewrites. Therefore, if all SR&T sites would deliver new techniques software in a form compatible with the modular system, virtually no additional programming would be required to conduct tests comparing new techniques with each other and/or with the base-line system. In addition, making use of programming conventions, documentation and data delivery standards will greatly enhance the ability of researchers at the various sites to understand and utilize the software developed at other sites. JSC should allocate funds and assign members of the research community to a task force responsible for the creation of such standards. Standards would be beneficial, even if a shared computational environment were unavailable.

8.4 Local Site Support Responsibilities.

One key component to effective use of any data processing system is the availability of an expert or consultant. These people are vital in the chain of communication between the people who maintain the system and the researchers attempting to make use of the system. In order to maximize the benefits which can be derived from the shared system, it will be convenient to establish a local site expert at each site. The site expert should be a technical specialist, familiar with computer programming as well as the technical aspects of typical remote sensing data processing software. At most sites it would probably be convenient for this person to double as a programmer. Site experts will need to spend two or more one-week periods a year becoming intimately familiar with the processing network, new software utilities which have been added, reviewing problems, etc. with his peers at other sites.

Each local site should also identify a person to serve as a computational resources manager. This person will be responsible for interfacing with the network in order to secure and maintain the computational resources necessary to support users at his local site. Depending upon the amount of activity at the local site, the resources manager and the site expert may be the same person.

8.5 Establish Training Course.

A detailed training course for users of the network should be formulated; including:

1. How to access and use the computer system.
2. How to access and use the baseline software.
3. How to use special SR&T utilities (batch, SR&T News, data search, etc.).
4. Programming conventions for research software (e.g., baseline system compatibility, universal format capability, commenting practices, transferability, etc.).
5. Documentation standards.
6. Standard algorithm evaluation and test procedures.

7. Procedures for requesting data.
8. Others.

The CMS short course is a first step towards accomplishing number 1 and 3 above.

APPENDIX A
WORKING DOCUMENT FOR 3031 INSTALLATION

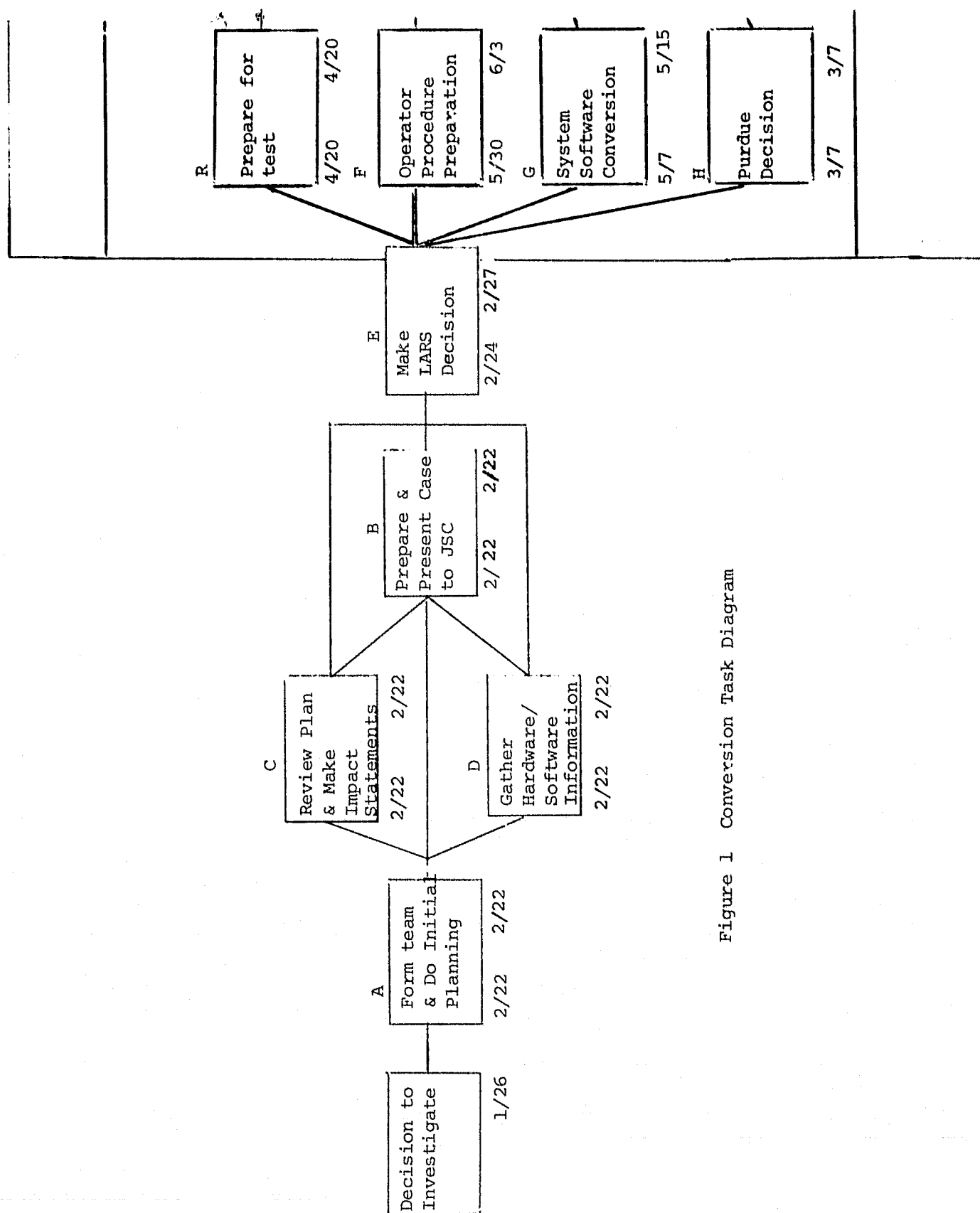
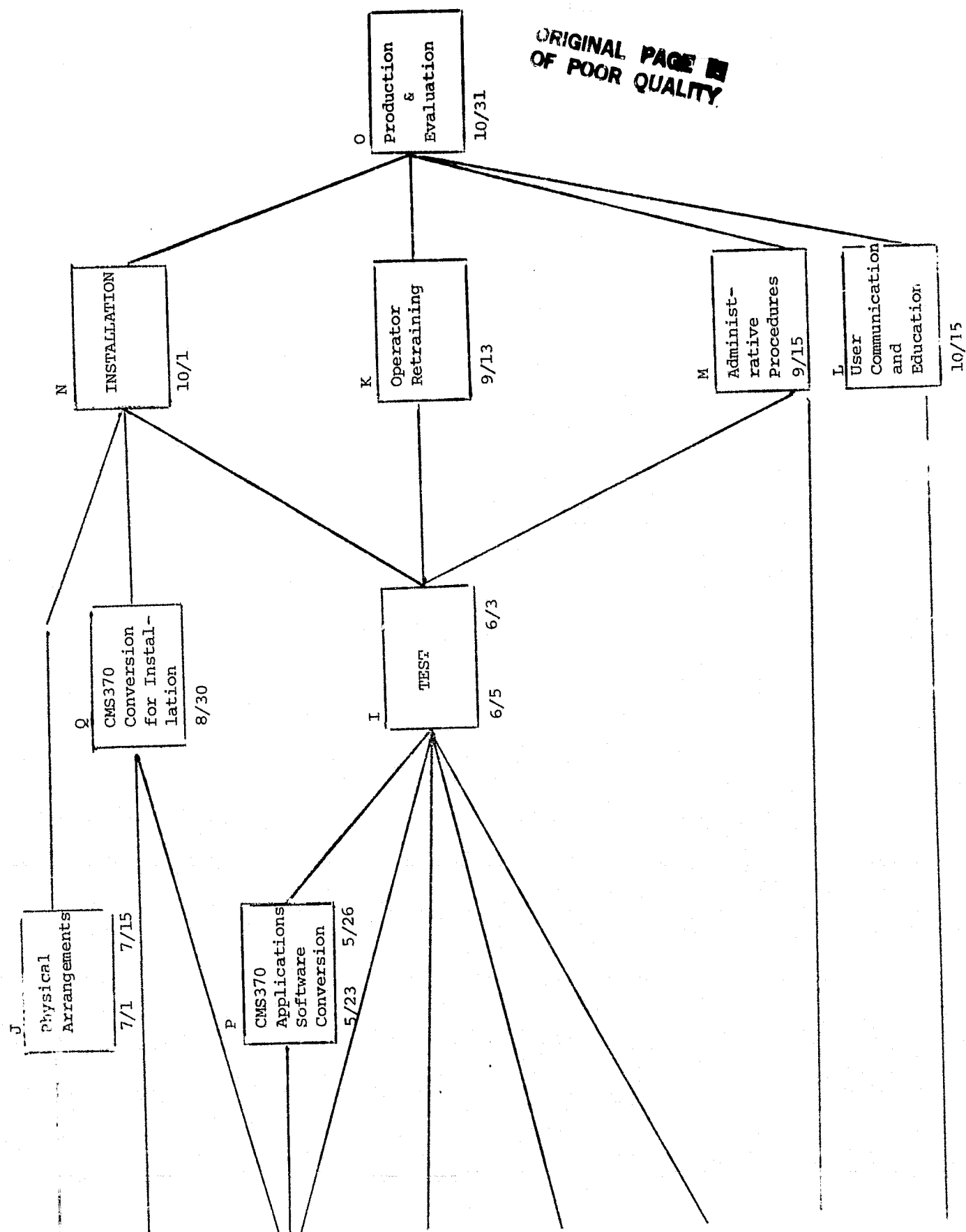


Figure 1 Conversion Task Diagram

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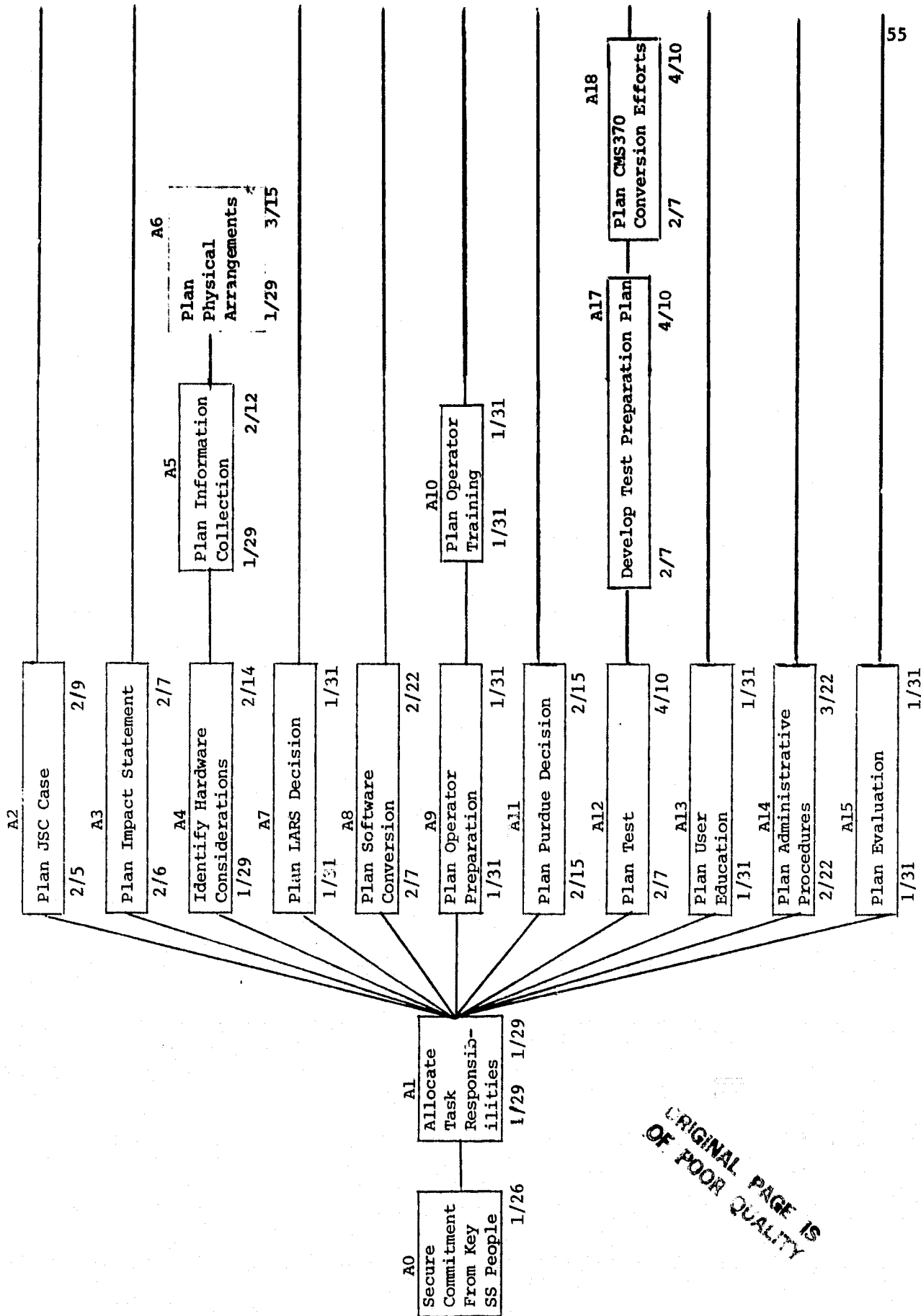
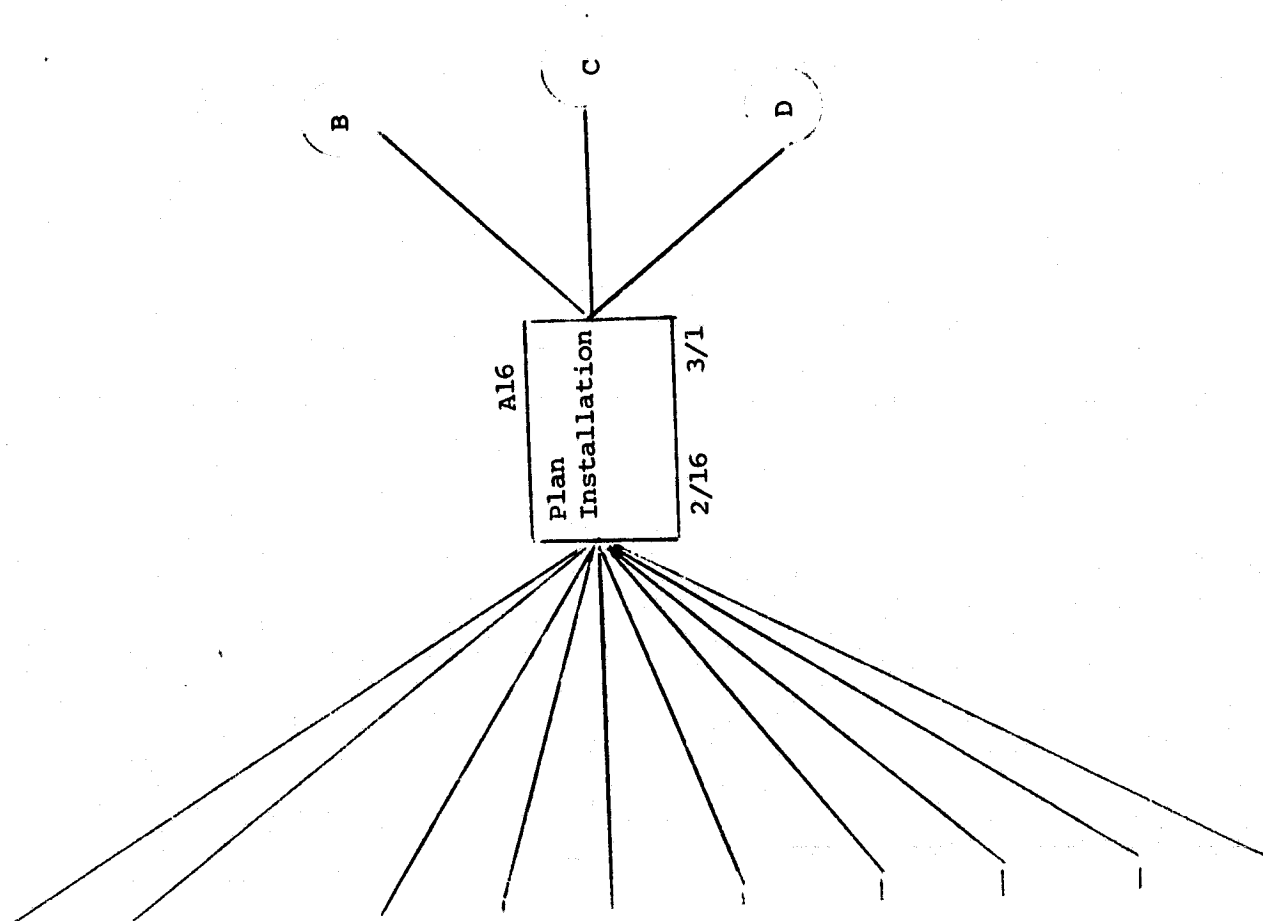


Figure A: Form Team and Do Initial Planning

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A. Form Team and Do Initial Planning

A0 Secure Commitment from Key System Services People

Conduct meeting with Terry Phillips, Ross Garmoe, Keith Philipp, Jeanne Etheridge, and Mike Collins. Explain opportunity, secure commitment.

Kast 1 man day 1/26/79

A1 Allocate Task Responsibility

Conduct team meeting and allocate responsibilities. Distribute Initial Planning Block Diagram and assign planning activities. Select next meeting time.

Kast 2 man days 2/6/79

A2 Plan JSC Case Kast & Phillips

Kast 1 man days 2/9/79

A3 Plan Impact Statement

Plan the identification of impacts on SS projects (370 conversion, display, etc) Etheridge, Freeman, Garmoe.

Etheridge 1 man days 2/6/79

A4 Identify Hardware/Software Considerations Garmoe & Philipp

Should identify the significant hardware changes necessary, and those important hardware/software components should be verified (2314 disks, Digital Display, CMS360, etc.).

Garmoe 1 man days 2/11/79

A5 Plan Information Collection Philipp & Garmoe

Plan tests and verification of problems turned up under A4.

Philipp 1 man days 2/7/79

A6 Plan Physical Arrangements Collins, Garmoe

Collins 1 man days 1/31/79

A7 Plan LARS Decision

Kast and Phillips should define the information needed and the presentation mode to be used in order for LARS to make the decision to attempt to acquire the 3031.

Kast .5 man days 1/31/79

A8 Plan Software Conversion

Garmoe & Philipp should identify those systems software which must be converted in order to support the 3031 and what tests should be conducted in order to confirm proper functioning of that software.

Garmoe 1 man days 2/7/79

A9 Plan Operator Preparation

| | | |
|---------|-------------|---------|
| Collins | .5 man days | 1/31/79 |
|---------|-------------|---------|

A10 Plan Operator Training

| | | |
|---------|-------------|---------|
| Collins | .5 man days | 1/31/79 |
|---------|-------------|---------|

A11 Plan Purdue Decision

Assuming a positive response by LARS towards the acquisition of the 3031, activity is likely to be required of Phillips, Landgrebe and G. Peterson in order to secure Purdue approval.

| | | |
|----------|------------|---------|
| Phillips | 2 man days | 2/15/79 |
|----------|------------|---------|

A12 Plan Test

Philipp, Etheridge & Freeman

Systems, Reformatting, applications such as LARSYS and LARSYSPl, statistical packages, accounting and other software should be benchmarked on an available 3031 configured as closely as possible to match the projected LARS system.

| | | |
|---------|------------|--------|
| Philipp | 2 man days | 2/7/79 |
|---------|------------|--------|

A13 Plan User Education and Communication

| | | |
|-----------|-------------|---------|
| Etheridge | .5 man days | 1/31/79 |
|-----------|-------------|---------|

A14 Plan Administrative Procedures

| | | |
|----------|------------|---------|
| Phillips | 3 man days | 2/22/79 |
|----------|------------|---------|

A15 Plan Evaluation

| | | |
|------|-------------|---------|
| Kast | .5 man days | 1/31/79 |
|------|-------------|---------|

A16 Plan Installation

| | | |
|---------------|------------|---------|
| Garmoe & Kast | 3 man days | 2/16/79 |
|---------------|------------|---------|

A17 Develop Test Preparation Plan

Develop a plan for benchmark testing of the 3031 and acquiring the software and data needed to support the test.

| | | |
|----------------|------------|---------|
| Kast & Shelley | 6 man days | 4/10/79 |
|----------------|------------|---------|

A18 Plan CMS370 Conversion Efforts

| | | |
|-----------|------------|---------|
| Etheridge | 6 man days | 4/10/79 |
|-----------|------------|---------|

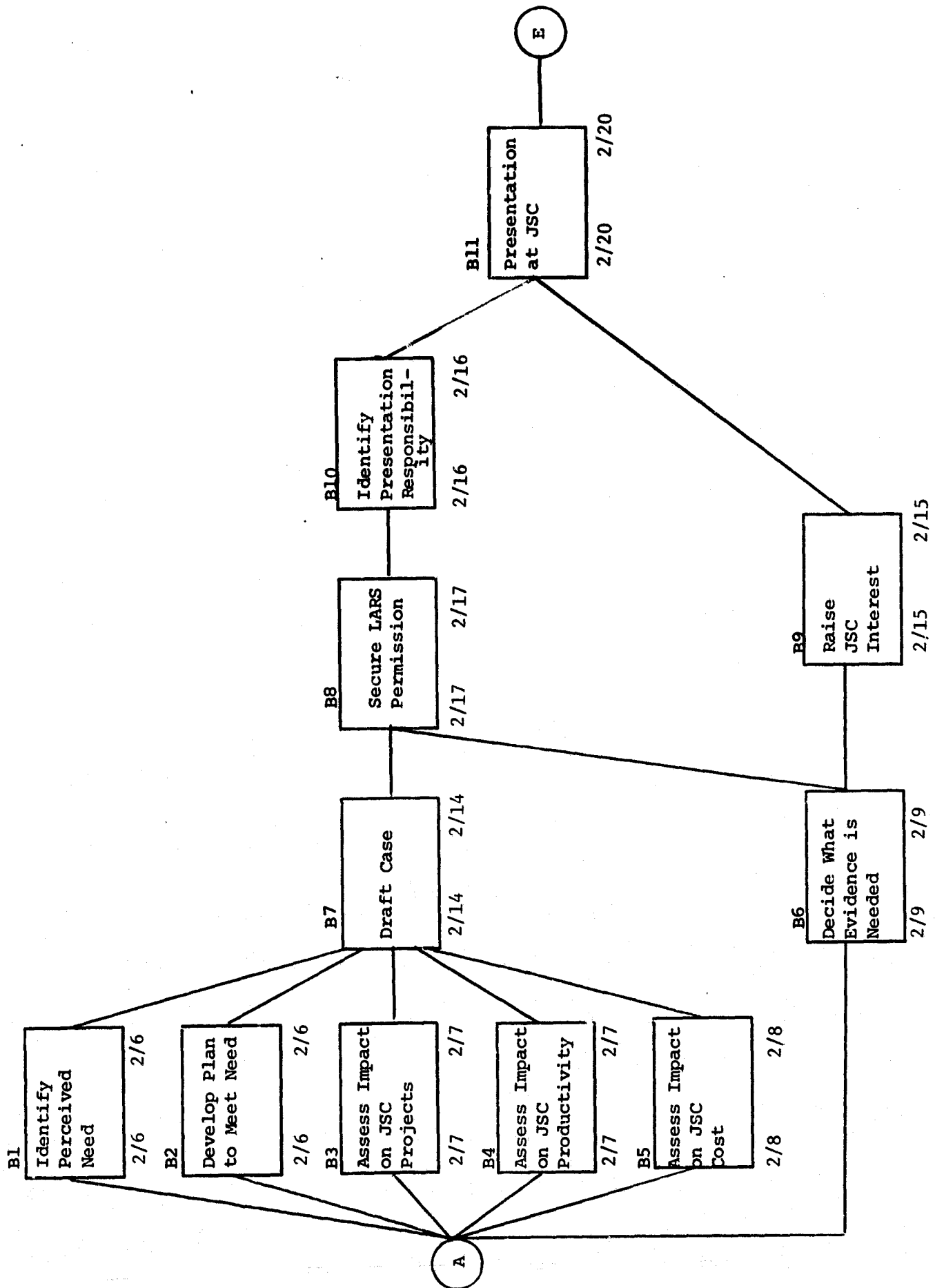


Figure B: Prepare & Present Case to JSC

B. Prepare and Present Case to JSC

B1 Identify Perceived Need

Gather LARS internal and JSC supplied evidence that the LARS system 370 Model 148 computer is insufficient to handle the joint computational needs of LARS and JSC.

Kast 2 man days 2/6/79

B2 Develop Plan to Meet Need

By reviewing the resources identified through the initial planning process, comparing those resources to the resources available within the computer facility and the computer processing support project over the period of the plan. This task requires the cooperation and input of System Service project managers.

Kast. 2 man days 2/6/79

B3 Assess Impact on JSC Projects

Kast 1 man day 2/7/79

B4 Assess Impact on JSC Productivity

Kast 1 man day 2/7/79

B5 Assess the Impact on JSC Cost

Given the expected JSC usage based on B1

Kast 1 man day 2/8/79

B6 Decide What Evidence is Needed from JSC

Based on discussion in Directors' Meeting and with 3A project manager, document the range of evidence needed from JSC.

Kast 1 man day 2/9/79

B7 Draft Case to be Presented for LARS Permission and later to JSC.

Kast. 2 man days 2/14/79

B8 Secure LARS permission to talk with JSC about acquisition of 3031 in Directors' meeting and Program Leaders Meeting.

Phillips 1 man day 2/15,16,17/79

B9 Raise JSC interest in 3031 acquisition and lay groundwork for presentation of LARS proposal for 3031 acquisition.

Phillips .3 man days 2/15/79

B. Continued

B10 Identify presentation and responsibility during Program Leaders Meeting or Directors' Meeting on 2/15-16/79.

| | | |
|----------|------------|---------|
| Phillips | 1 man days | 2/16/69 |
|----------|------------|---------|

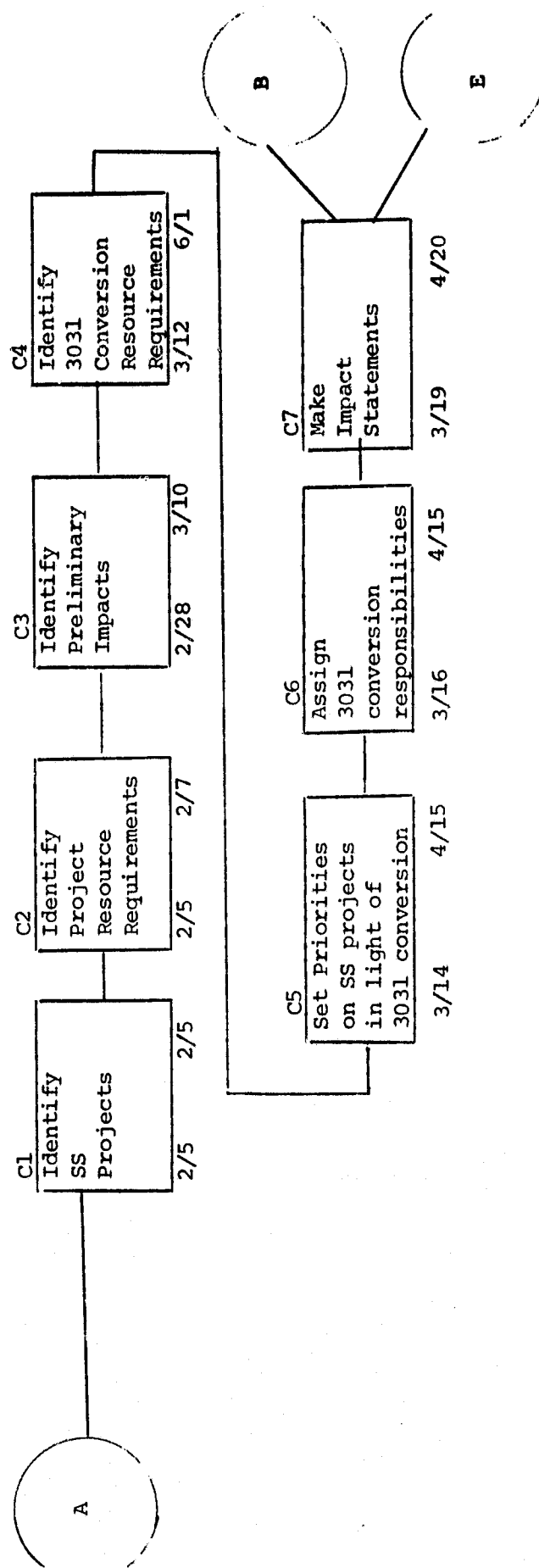
B11 Make presentation to JSC to Jon Erickson, Don Hay and possible other JSC personnel.

| | | |
|----------|------------|---------|
| Phillips | 3 man days | 2/20/79 |
|----------|------------|---------|

Task B Total

| | | |
|------|-------------|---------|
| Kast | 16 man days | 2/20/79 |
|------|-------------|---------|

C: PLAN IMPACT STATEMENTS



C. Plan Impact Statement

C1 Identify System Services Projects

Obtain list of projects from managers.

| | | |
|-----------|-------------|--------|
| Etheridge | 1/2 man day | 2/5/79 |
|-----------|-------------|--------|

C2 Identify Project Resource Requirements

Ask managers to complete project lists by adding personnel and percentages spent on projects.

| | | |
|-----------|-------------|--------|
| Etheridge | 1/2 man day | 2/5/79 |
|-----------|-------------|--------|

C3 Identify Preliminary Impacts

Ask managers which projects may be impacted and which personnel and percentages are then available for 3031 project.

| | | |
|---------------------|------------|---------|
| Etheridge, Phillips | 3 man days | 2/28/79 |
|---------------------|------------|---------|

C4 Identify 3031 Conversion Resource Requirements

Review plan and add up days needed for personnel for each month.

| | | |
|------|------------|---------|
| Kast | 2 man days | 3/12/79 |
|------|------------|---------|

C5 Review and Set Priorities on System Service Projects in light of 3031 Project.

| | | |
|------------------------|-----------|---------|
| Phillips, all managers | 1 man day | 3/14/79 |
|------------------------|-----------|---------|

C6 Assign 3031 Conversion Responsibilities

| | | |
|--------------------|-----------|---------|
| Kast, all managers | 1 man day | 3/16/79 |
|--------------------|-----------|---------|

C7 Make Impact Statement

Based on all of above, summarize impact of 3031 conversion on System Services Projects.

| | | |
|-----------|------------|---------|
| Etheridge | 2 man days | 3/19/79 |
|-----------|------------|---------|

Task C Total

| | | |
|-----------|-------------|---------|
| Etheridge | 10 man days | 3/19/79 |
|-----------|-------------|---------|

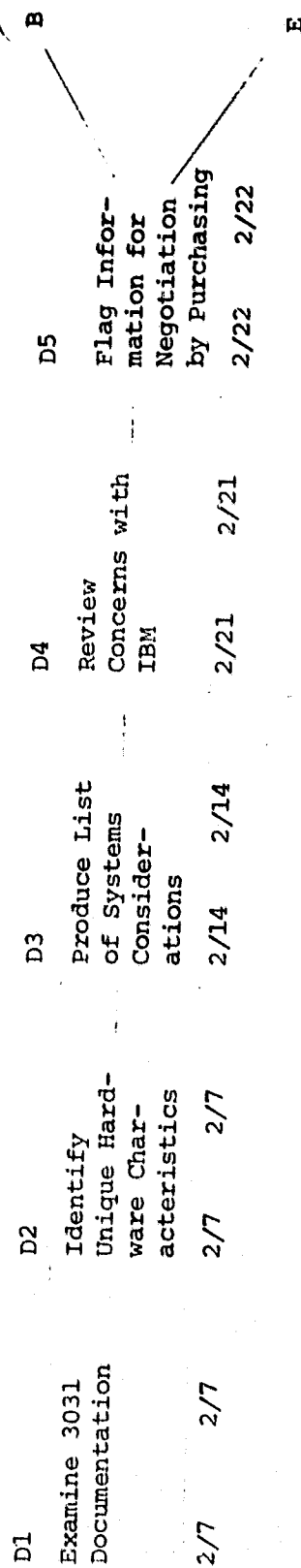


Figure D: Gather Hardware/Software Information

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D. Gather Hardware/Software Information

- | | | | |
|----|--|------------|---------|
| D1 | Examine 3031 Documentation. | | |
| | Garmoe & Philipp | 6 man days | 2/7/79 |
| D2 | Review the unique characteristics of the LARS system with 3031 compatibility in mind. | | |
| | Garmoe | 2 man days | 2/7/79 |
| D3 | Based on D1 and D2, produce a list of hardware/software concerns. | | |
| | Garmoe | 2 man days | 2/14/79 |
| D4 | Review concerns from D3 with IBM. | | |
| | Garmoe | 1 man day | 2/21/79 |
| D5 | Flag concerns for negotiation between Purdue Purchasing and IBM (see Boxes M16 and M17). | | |
| | Kast | 2 man days | 2/22/79 |

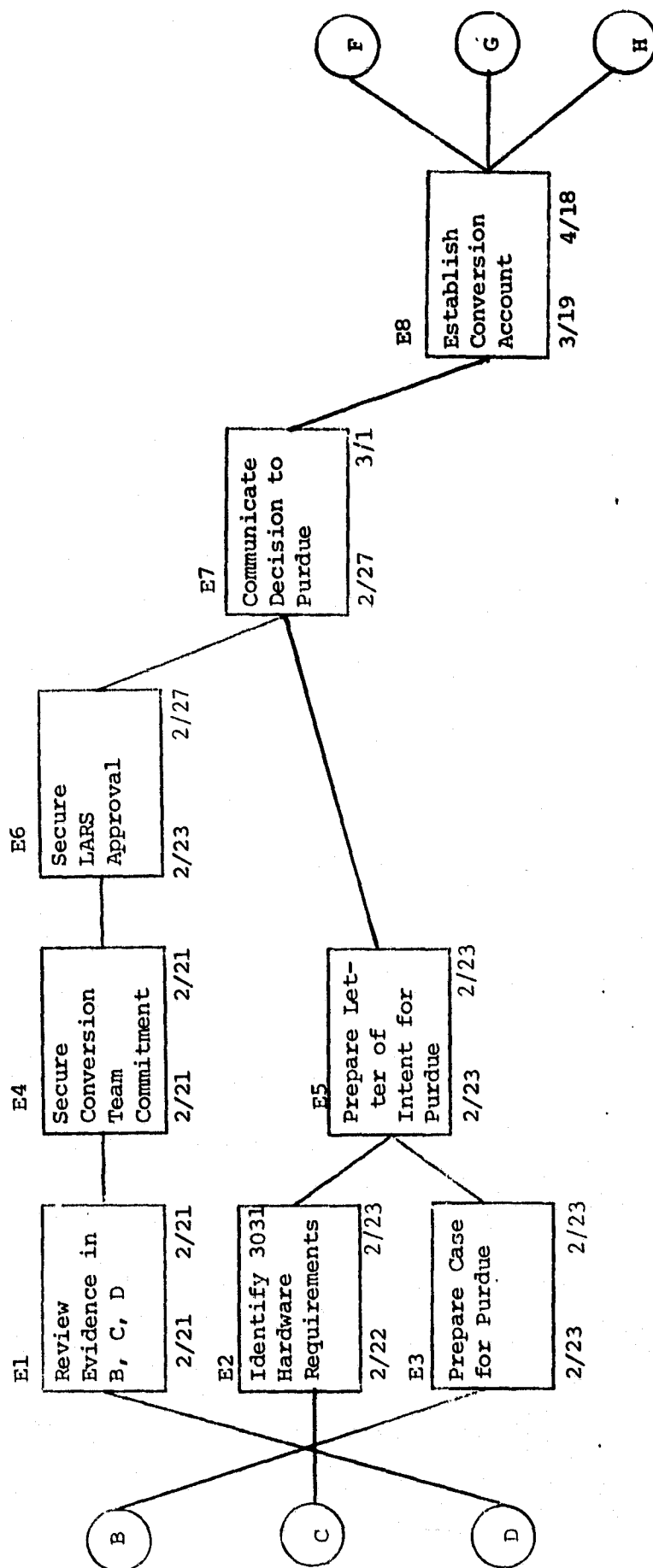


Figure E: LARS Decision

E. Make LARS Decision

E1 Review Evidence Resulting from Work on Impact Statement, Hardware/Software Considerations, and the Verbal and Expected Written Responses from JSC during a 3031 conversion team meeting.

Review the risk and opportunities in light of this evidence.

| | | |
|----------|------------|---------|
| Phillips | 2 man days | 2/21/79 |
|----------|------------|---------|

E2 Identify 3031 Hardware Requirements.

Quantities and model number of each component of the 3031 we plan to order and each component of the 148 we plan to discontinue should be documented for inclusion in our letter of intent to Purdue University. (Box E5)

| | | |
|--------|-----------|---------|
| Garmoe | 1 man day | 2/22/79 |
|--------|-----------|---------|

E3 Prepare Case for Purdue by Documenting the evidence and the criteria under which LARS is seeking to acquire the 3031.

| | | |
|----------------|-----------|---------|
| Kast, Phillips | 1 man day | 2/22/79 |
|----------------|-----------|---------|

E4 Secure Conversion Team Commitment

On the basis of the information presented in Box E1, secure personnel commitment to the pursuit of the 3031 by each member of the conversion team.

| | | |
|------|-----------|---------|
| Kast | 1 man day | 2/21/79 |
|------|-----------|---------|

E5 Prepare Letter of Intent for Purdue University.

Combine information in Boxes E2 and E3 in a suitable form and present to Dave Landgrebe.

| | | |
|------|-----------|---------|
| Kast | 1 man day | 2/23/79 |
|------|-----------|---------|

E6 Secure LARS Approval during Program Leaders Meeting 2/23/79 by reviewing Boxes E1 and E4 for Program Leaders Meeting.

The entire conversion team should be present at this meeting.

| | | |
|------|-----------|---------|
| Kast | 1 man day | 2/23/79 |
|------|-----------|---------|

E7 Communicate Decision to Purdue

| | | |
|-----------|------------|---------|
| Landgrebe | 2 man days | 2/27/79 |
|-----------|------------|---------|

E8 Establish conversion account.

| | | |
|----------|-----------|---------|
| Phillips | 1 man day | 3/19/79 |
|----------|-----------|---------|

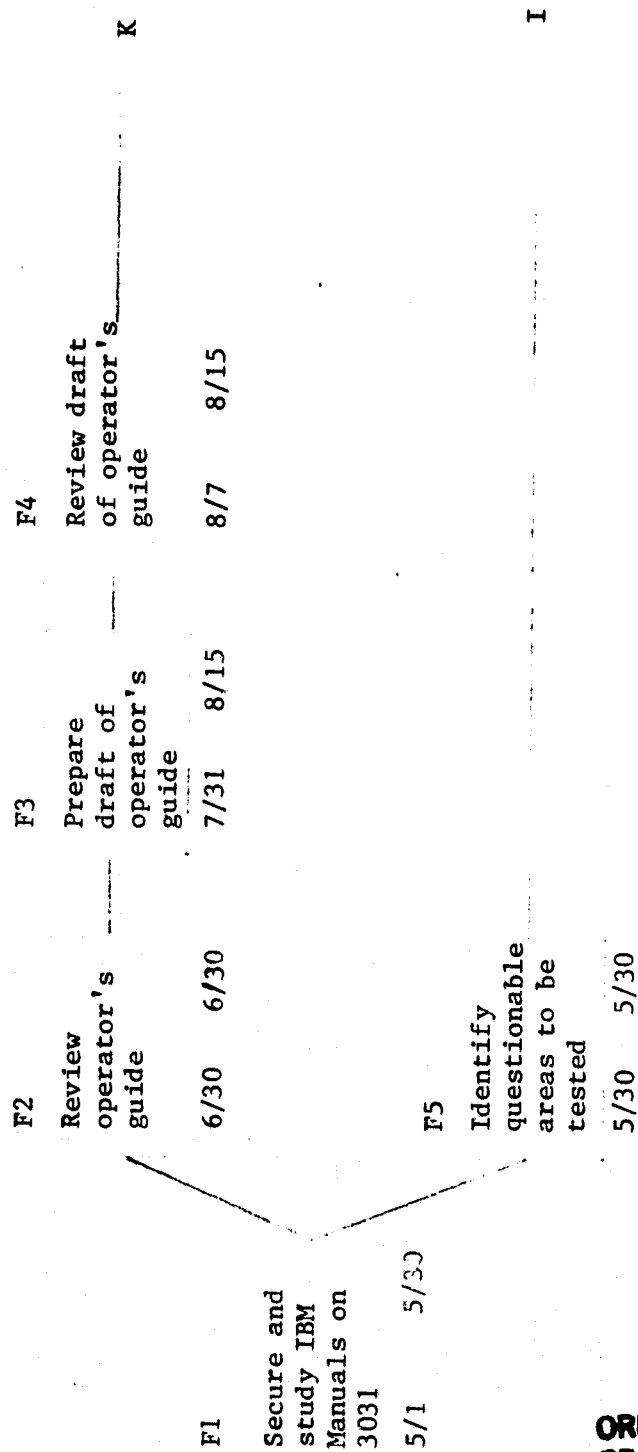


Figure F: Operator's Procedure Preparation

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F. OPERATORS PROCEDURE PREPARATION

- | | | | |
|-----|---|------------|------|
| F1. | Study the IBM manuals on the 3031 system. | | |
| | Collins | 4 man days | 5/1 |
| F2. | Review existing computer operator's guide to determine areas that will need to be changed or rewritten. | | |
| | Collins | 3 man days | 6/30 |
| F3. | Prepare rough draft of Computer Operator's Guide. | | |
| | Collins | 4 man days | 7/3 |
| F4. | Review draft with Basic Systems Group. | | |
| | Collins | 2 man days | 8/7 |
| F5. | Identify any questionable areas that will need to be tested during the Washington tests (if needed). | | |
| | Collins | 1 man day | 5/30 |

Figure G. Software Conversion

G. SOFTWARE CONVERSION

- G1. Install LARS modifications into VM370 Rel 5, PLC 12. Test modified system, and install as production system on LARS 370/148.
 Philipp 10 man days 4/11
- G2. Negotiate test site configuration.
 Garmoe 1 man day 4/9
- G3. Define set of tests for CP, CMS and RSCS and the required operational levels and test results.
 Garmoe 3 man days 4/20
- G4. Define libraries and test materials required to perform testing at test site.
 Philipp 1 man day 4/20
- G5. Validate operation of CP, CMS and RSCS on LARS 370/148 using tests and test materials defined above, using system generated in G1.
 Philipp 2 man days 4/16
- G6. Freeze production system and configuration, except for mandatory changes.
 Garmoe 1 man day 5/1
- G7. Generate LARS system for test on 3031. Involves modifications to DMKRIO, DMKSYS, DMKCPI and DMKCKP and generating IPL tape. Also generation of 3705 EP program and test system directory.
 Philipp 6 man days 5/7
- G8. Prepare test materials for transfer to test 3031 in most appropriate manner. May be 3330 packs and/or tapes.
 Garmoe 4 man days 5/7
- G9. Determine the channel configuration of the LARS 3031.
 Garmoe 1 man day 4/1

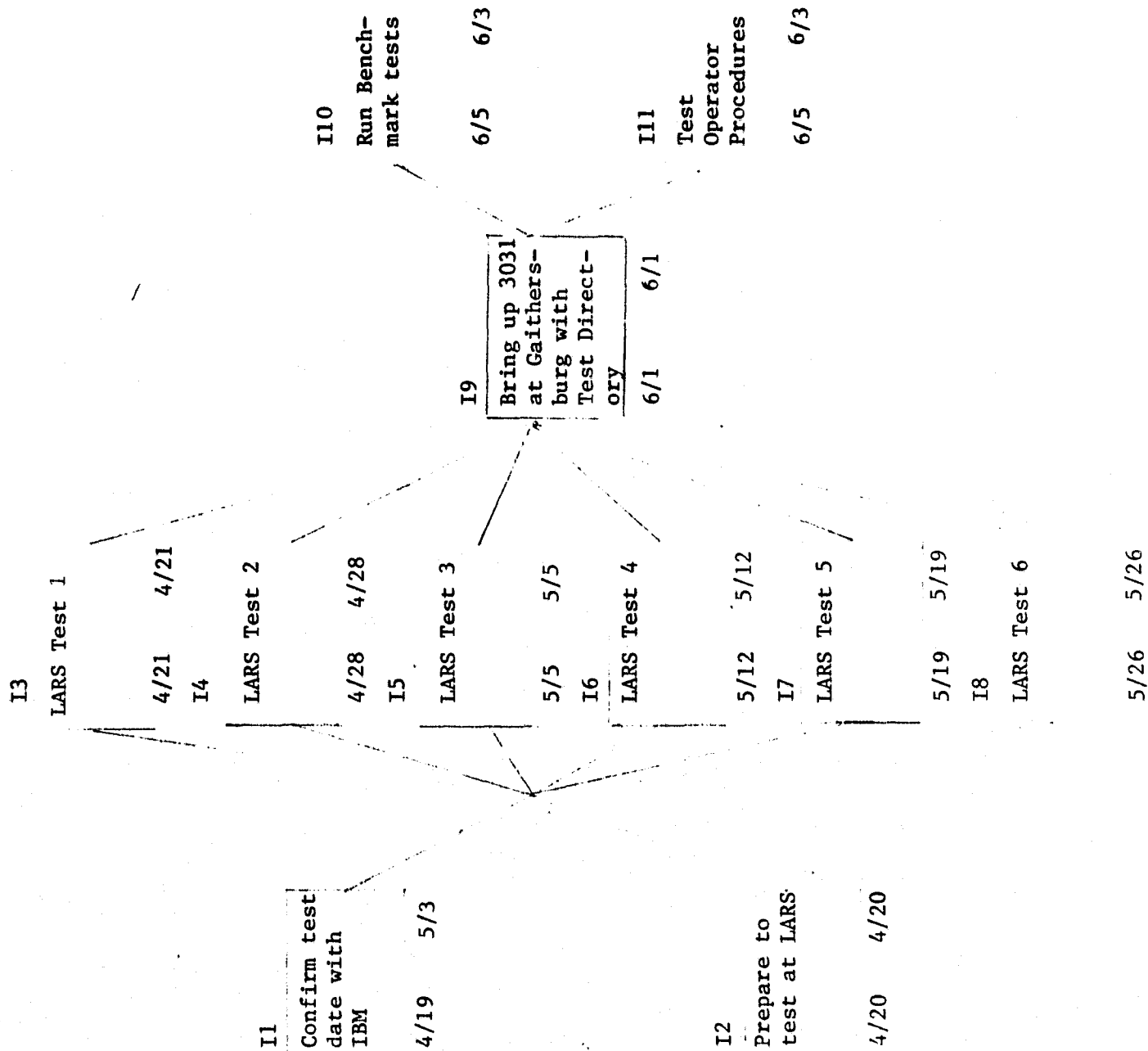
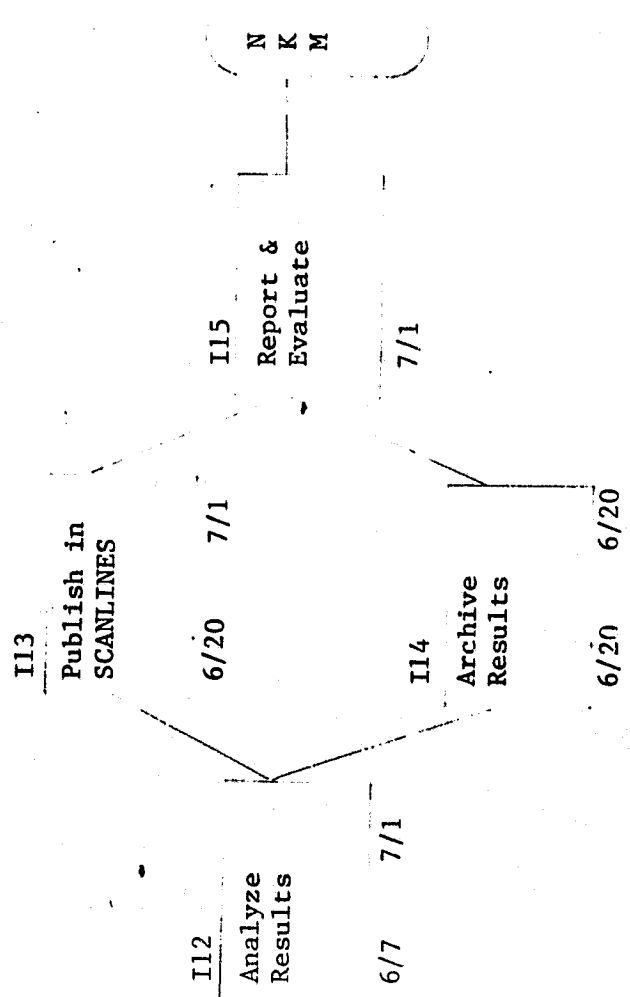


Figure I: Perform 3031 Test

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I. Pre-Installation 3031 Test

- | | | | |
|------|--|-------------|------|
| I1. | Confirm the test date requested for Gaithersburg under Box R with IRM. | | |
| | Kast | 1 man day | 4/19 |
| I2. | Reserve the 148 for Saturday evenings, and arrange for operators for those evenings. | | |
| | Kast | 1 man day | 4/20 |
| I3. | Prepare for and run CPU Strain Test using LARSYS, CLUSTER and LARSYSPI Classify. Involves Kast, Shelley, Lang and operator. | | |
| | Shelley | 6 man days | 4/21 |
| I4. | Run Standard Mix Test using LARSYSPI, EDIT string LARSYS, SPSS and the FORTRAN H compiler; optimize 1 and 2. | | |
| | Shelley | 6 man days | 4/28 |
| I5. | Run Standard Mix Test, using the processing in Box I4, intensive CPU and intensive paging background loads on the system. | | |
| | Kast | 7 man days | 5/5 |
| I6. | Run the Paging Strain Test, using a progression of Geometric Correction jobs running simultaneously. | | |
| | Shelley | 6 man days | 5/12 |
| I7. | Run JSC Software Benchmarks on Procedure M (if available), LARSYS-P2, CLASSY, TAPTRAN, LAW of the Minimum and Generalized Analysis of Variance Software. | | |
| | Shelley | 6 man days | 5/9 |
| I8. | Run LARS Software Benchmark (for rate establishment) on EXOSYS, Referts, IMSL and CP accounting. | | |
| | Etheridge | 6 man days | 5/26 |
| I9. | Bring up 3031 at test site with test directory. | | |
| | Garmoe | 3 man days | |
| | Philipp | 3 man days | 6/1 |
| I10. | Test on 3031. Same tests as Boxes I3-I8. | | |
| | Shelley | 24 man days | 6/5 |
| I11. | Test operator procedures and gain operator experience. | | |
| | Collins | 5 man days | 6/5 |
| I12. | Analyse test results. | | |
| | Garmoe, Kast & Shelley | 5 man days | 6/7 |

- I13. Publish in SCANLINES. This will be done continuously to keep users informed.
Shelley 4 man days 6/20
- I14. Archive test results. Information may prove helpful during next machine conversion.
Shelley 2 man days 6/20
- I15. Report and Evaluation. Where were the bottlenecks and problem areas? How could it have been done better?
Shelley 4 man days 7/1

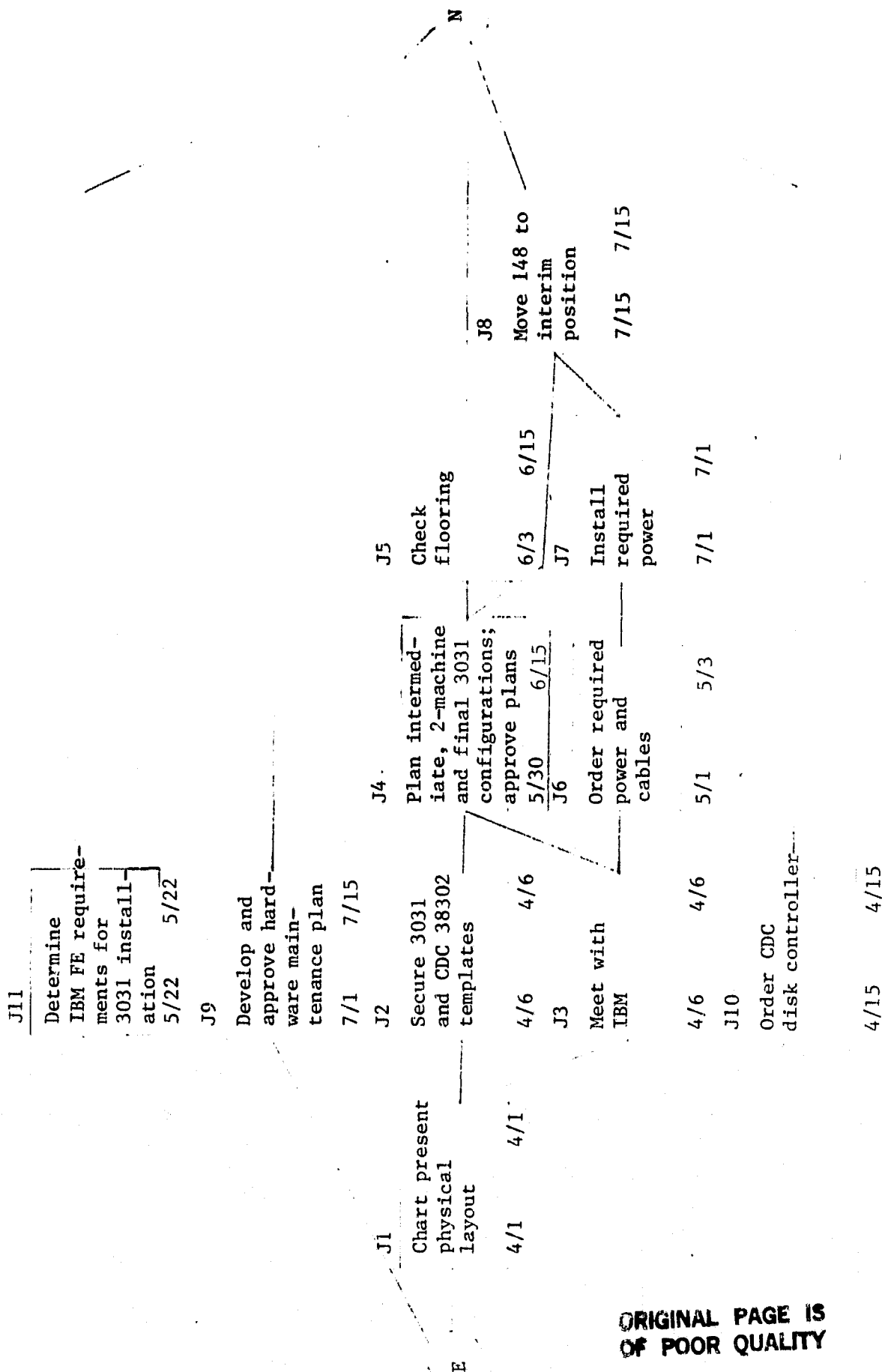


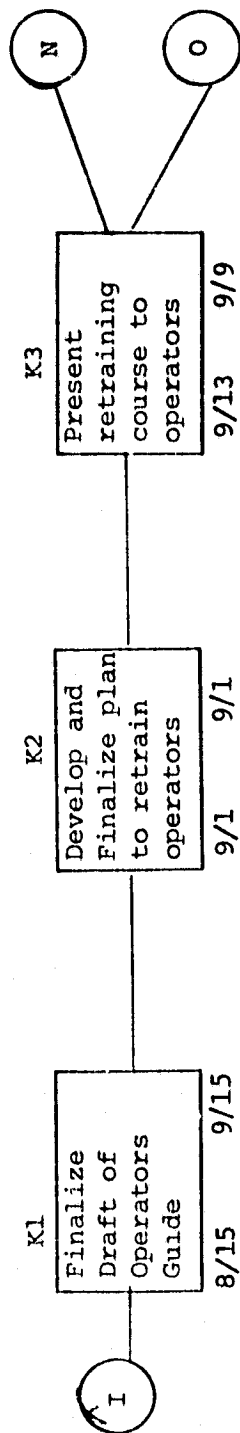
Figure J: Physical Planning

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J. Physical Planning

- J1. Chart present physical layout of computer room.
Collins 2 man days 4/1/79
- J2. Secure templates of the 3031 and CDC 38302 controller for use in planning layout.
Collins 1 man day 4/6/79
- J3. Meet with IBM site preparation man to secure power requirements, divide work on layout planning (J4), etc.
Collins 1 man day 4/6/79
- J4. Work with IBM to plan intermediate, 2-machine and final 3031 configurations. Secure approval of Project Manager (Kast) and Facility Manager (Phillips).
Collins & IBM 5 man days 5/30/79
- J5. Check flooring requirements in all three configuration plans (J4), and order new pieces if necessary. Cut flooring to accommodate power cables.
Collins 1 man day 6/3/79
- J6. Write order to electric suppliers for power receptacles as specified by IBM (J3), and an order to physical plant for installation in positions specified in layout plan. Order connector cables from IBM.
Collins 3 man days 5/1/79
- J7. Insure physical plant installs required power for 3031, console, IBM disk controller and CDC disk controller.
Collins 1 man day 7/1/79
- J8. Move 148 to interim position, clearing space for incoming 3031 hardware.
IBM 7/15/79
- J9. Work with IBM to ensure an appropriate hardware system maintenance plan is developed by Field Engineering.
Garmoe 3 man days 7/1/79
- J10. Order CDC 38302 disk controller.
Garmoe 1 man day 4/15/79
- J11. Determine IBM FE requirements for 148 move and 3031 installation.
IBM 5/22/79

Figure K
OPERATOR RETRAINING



K. Operator Retraining

- K1. Finalize the draft of the Computer Operators Guide that was begun in F.

Collins

10 man days

8/15/79

- K2. Develop and finalize plan for retraining and educating computer operators.

Collins

5 man days

9/1/79

- K3. Present the retraining course to the computer operators, together with operators' documentation.

Collins

10 man days

9/13/79

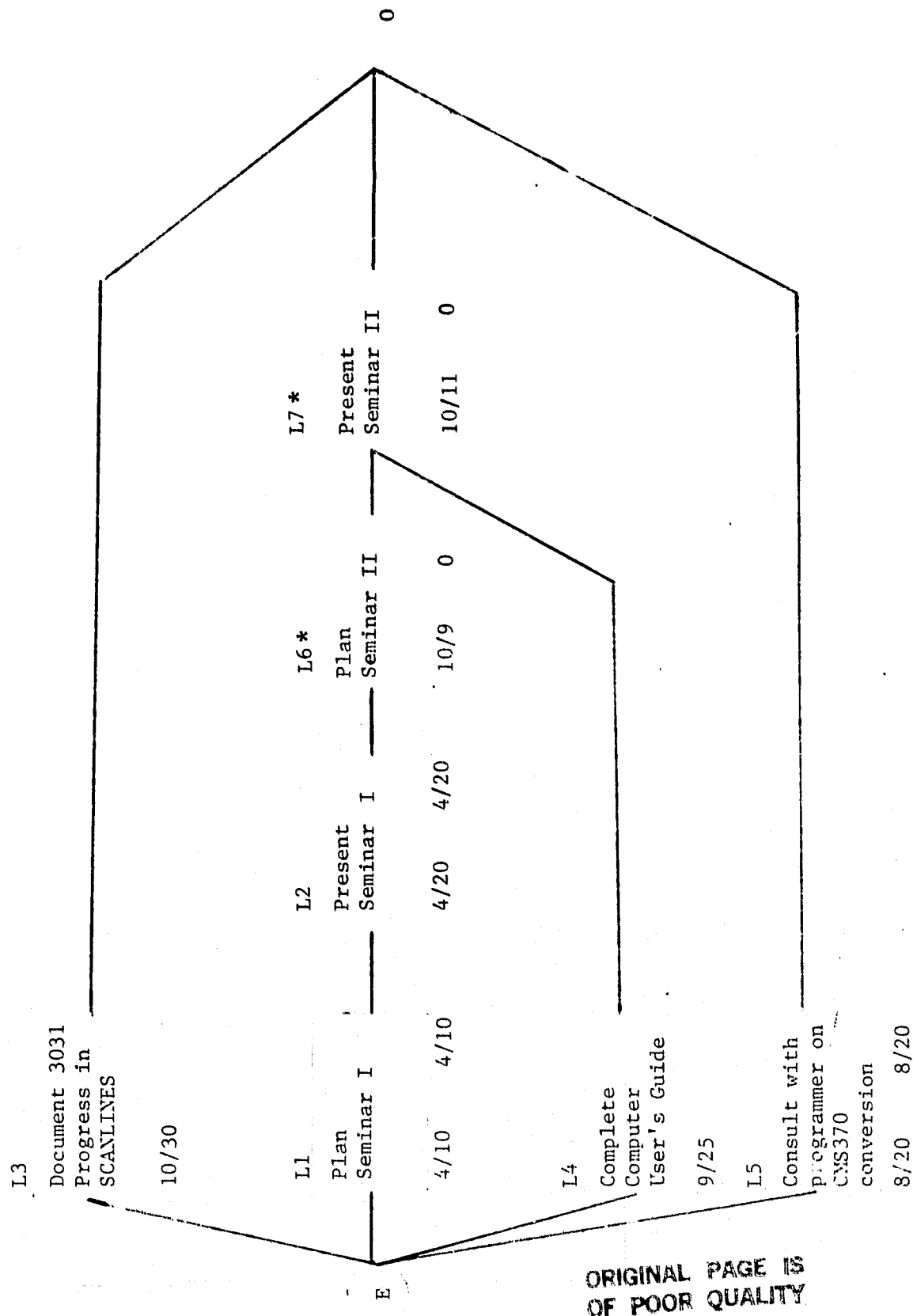


Figure L: USER EDUCATION & COMMUNICATION

* 0 indicates this task was omitted

L. User Education & Communication

L1. Plan Seminar I

Plan to present general information to users: why and how we will get the computer, testing plans, etc.

Kast 1 man day 4/10/79

L2. Present Seminar I

Planned under L1.

Kast $\frac{1}{2}$ man day 4/20/79

L3. Document 3031 Progress in SCANLINES

Keep users informed of 3031 progress, beginning in March, ending in November.

Etheridge 2 man days March - June
Shelley 2 man days July - October

L4. Complete Computer User's Guide

Revise for the 3031 and have copies available for distribution at Seminar II.

Garmoe 5 man days 9/25/79

L5. Consult with programmers on CMS370 Conversion

Help programmers with 370 conversion problems.

Etheridge 3 man days
Garmoe 1 man day 8/20/79

L6. Plan Seminar II

Review 3031 installation, down time, results, user impact and outline future plans.

Kast 2 man days 10/9/79

L7. Present Seminar II

Kast $\frac{1}{2}$ man day 10/1/79

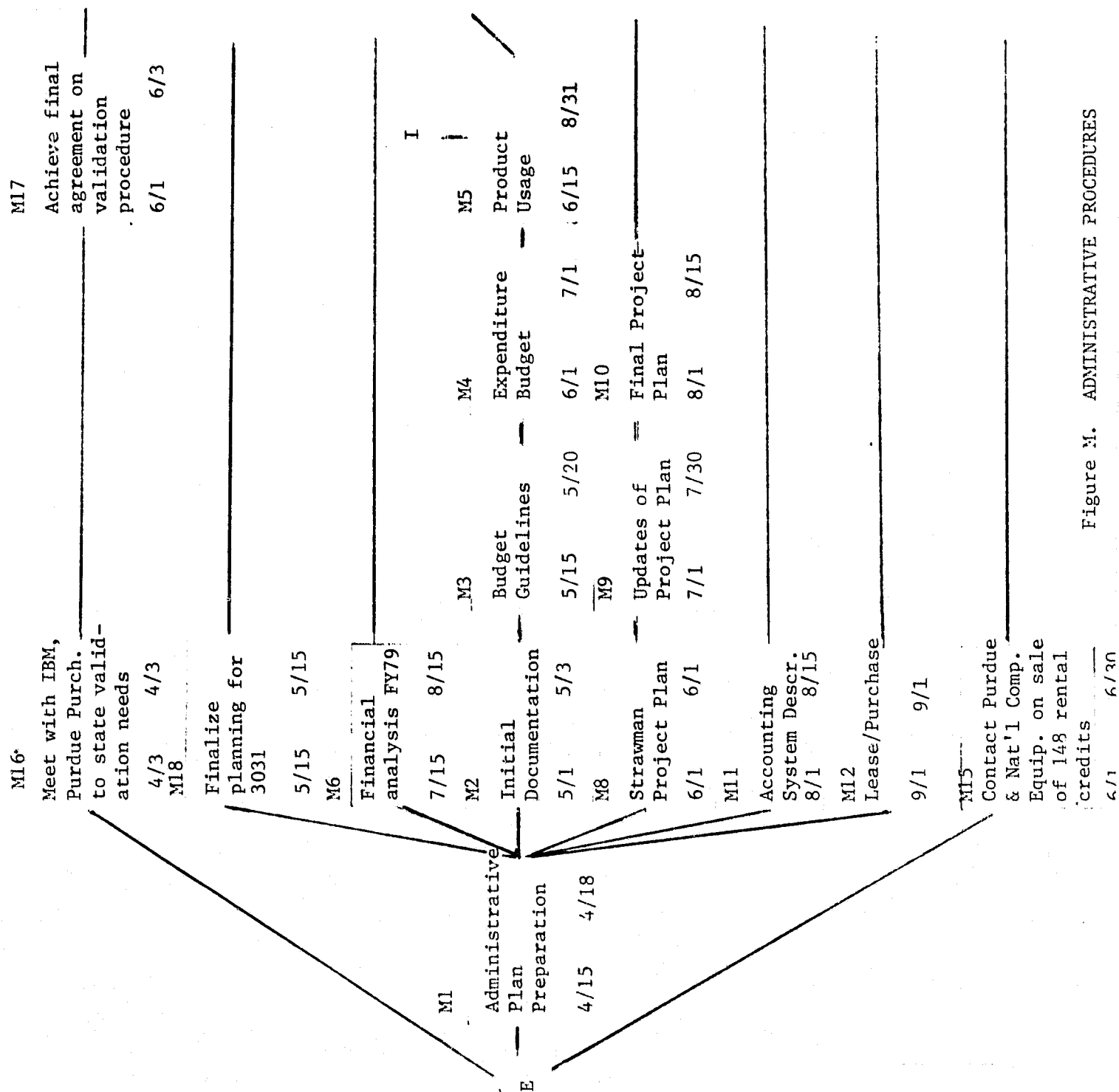
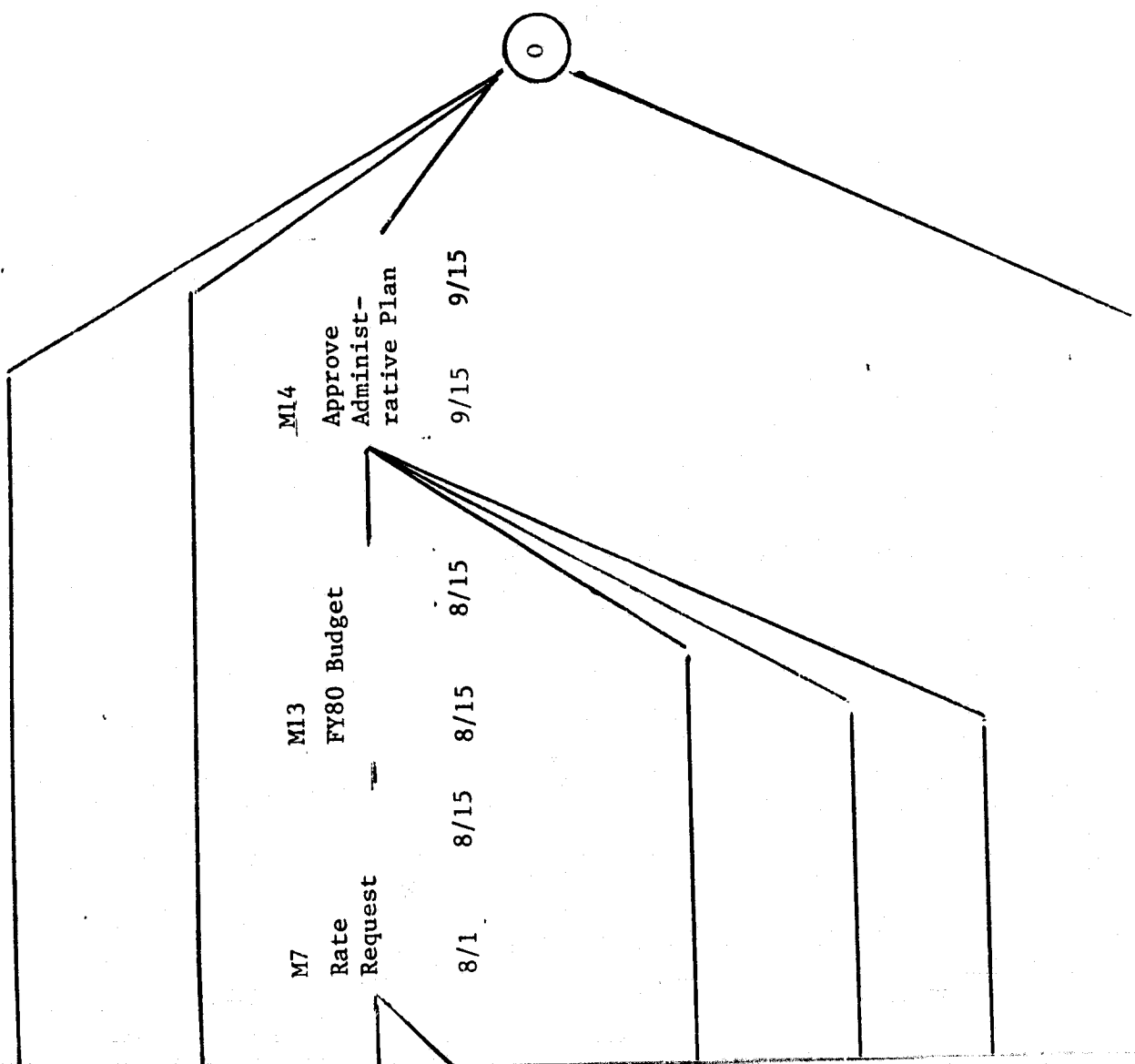


Figure M. ADMINISTRATIVE PROCEDURES



M. Administrative Procedures

- | | | | |
|------|---|-------------|---------|
| M1. | Meeting of Product Managers for instruction on Administrative Plan. | | |
| | Phillips | | |
| | Product Managers | 2 man days | 4/15/79 |
| M2. | Initial documentation of Chapters I through III of Administrative Plan. | | |
| | Phillips | 5 man days | 5/1/79 |
| M3. | Expenditure budget guidelines. | | |
| | Phillips | 2 man days | 5/15/79 |
| M4. | Expenditure budget with description of all items. | | |
| | Product Managers | 18 man days | 6/1/79 |
| M5. | Estimation of product usage. | | |
| | Product Managers | 6 man days | 6/15/79 |
| M6. | Financial analysis for FY79. | | |
| | Product Managers | 12 man days | 7/15/79 |
| M7. | Rate request | | |
| | Phillips | 2 man days | 8/1/79 |
| M8. | Initial System Service project plans. | | |
| | Phillips | 3 man days | 6/1/79 |
| M9. | Second Systems Service project plan | | |
| | Project Managers | 10 man days | 7/1/79 |
| M10. | Final System Service project plan. | | |
| | Phillips | 2 man days | 8/1/79 |
| M12. | Lease/Purchase analysis | | |
| | G. Peterson | 2 man days | 9/1/79 |
| M11. | System Services accounting system description. | | |
| | Collins | 5 man days | 8/1/79 |
| M14. | Approval of System Services administrative plan. | | |
| | Phillips | 2 man days | 9/15/79 |
| | Product Managers | | |
| M13. | Documentation and decisions regarding 1980 budget. | | |
| | Phillips | 3 man days | 8/15/79 |

- M15. Contact Purdue and National Computer Equipment Corporation on the sale of the 148 for the rental credits accrued over our two-year rental period.

Phillips

3 man days

6/1/79

- M16. Meeting of Systems Group, IBM and Purdue Purchasing to discuss our needs to insure an operational system upon installation of the 3031. The 4507 digital display and the 2314 disk system were of primary concern.

Kast

4 man days

4/3/79

- M17. Negotiate a final agreement with IBM on a procedure to validate the 3031 upon installation.

Purdue Purchasing

7 man days

6/1/79

- M18. Finalize planning for 3031 acquisition.

Kast

2 man days

5/15/79

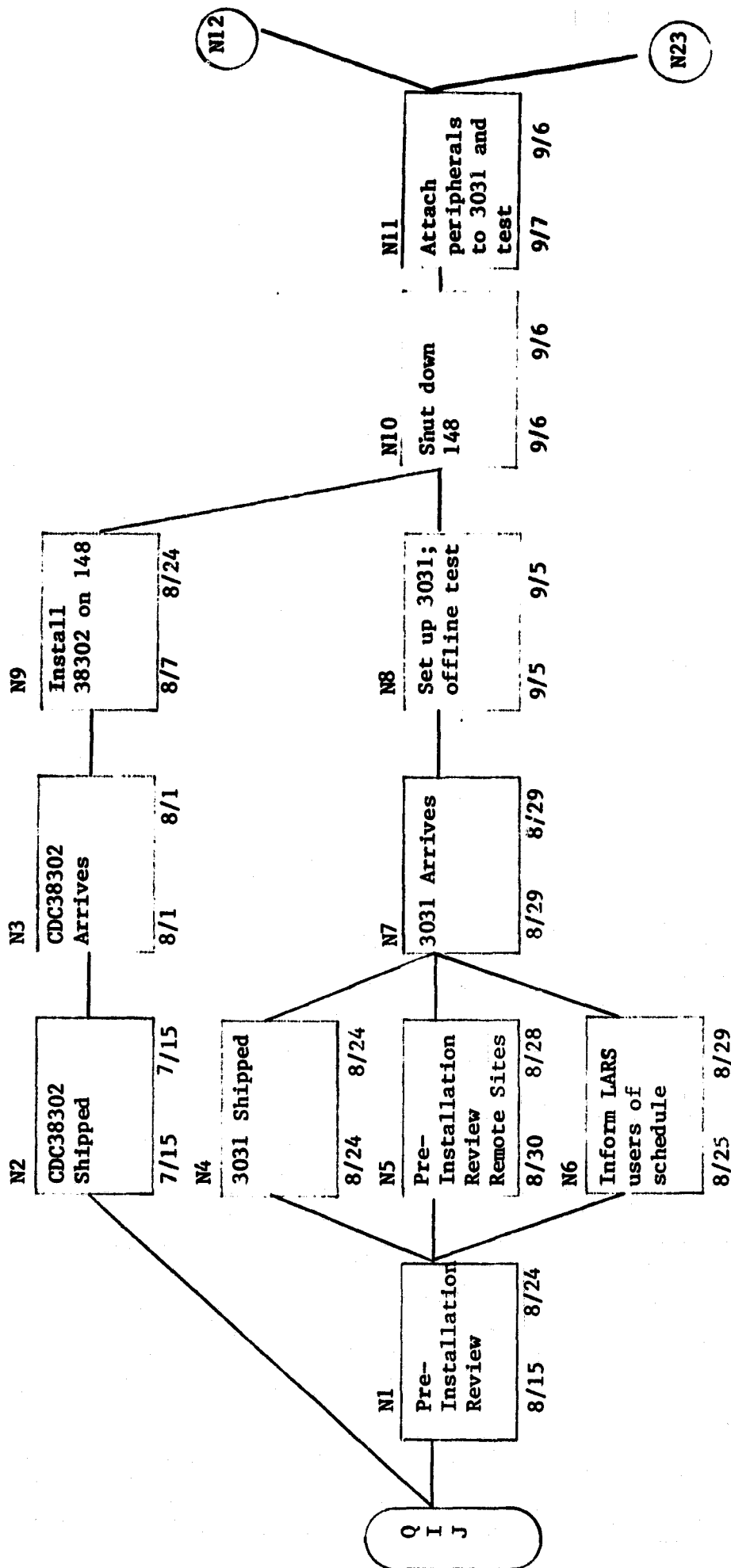
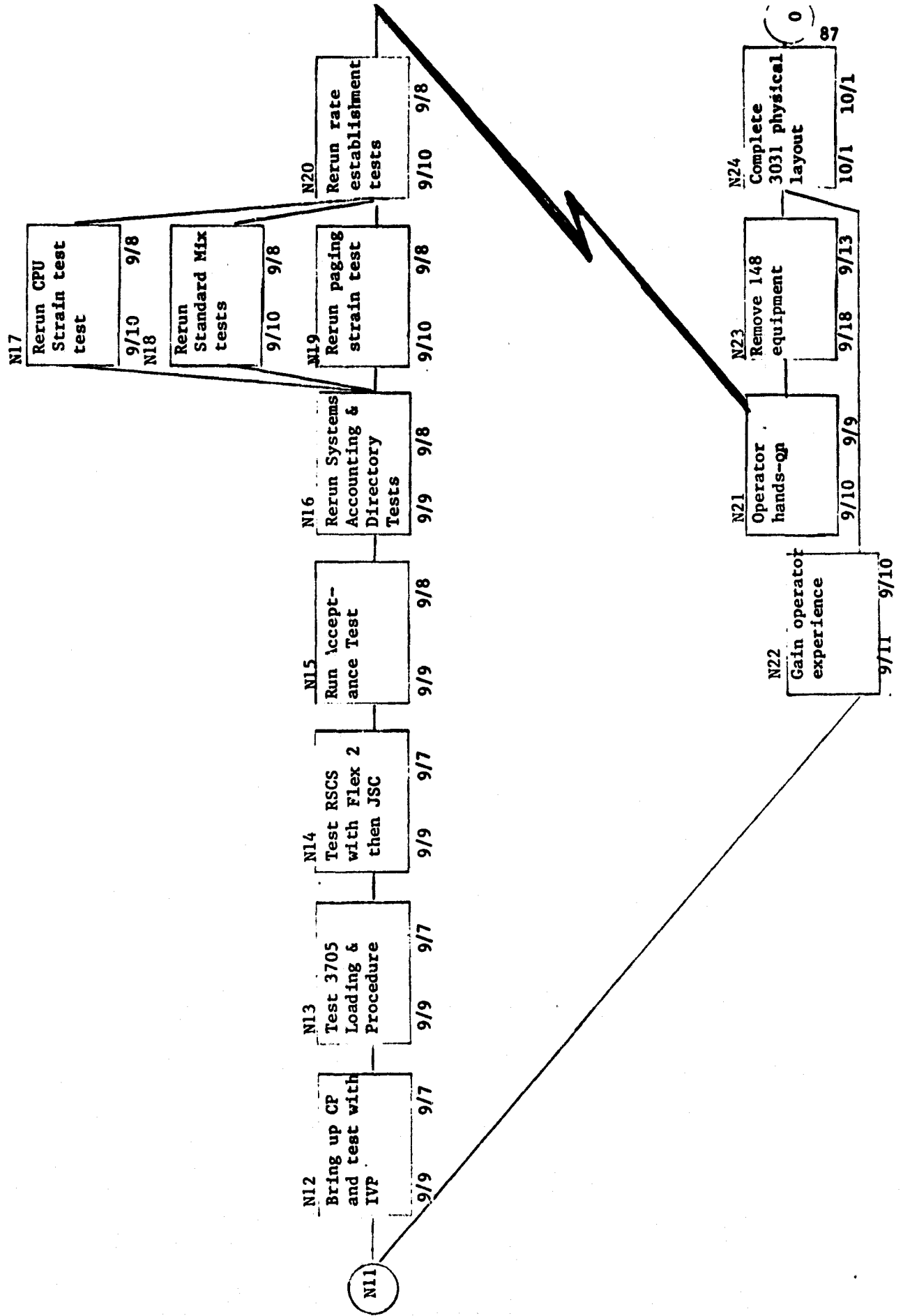


Figure N: Installation



N. 3031 Installation

- N1. Conduct a pre-installation review meeting between LARS and IBM representatives to finalize installation plans and establish a definite installation schedule.
 Kast 3 man days 8/15/79
- N2. Ship the CDC 38302 disk controller and cables from the factory.
 CDC 7/15/79
- N3. Receive the CDC 38302 disk controller and cables from the factory.
 CDC 8/1/79
- N4. Ship the IBM 3031 and its associated hardware from the factory.
 IBM 8/24/79
- N5. Conduct pre-installation review with remote terminal resource managers.
 Schwingendorf 2 man days 8/30/79
- N6. Inform LARS users of schedules for shutdowns, tests and operational startup of the new 3031 system.
 Kast 1 man day 8/25/79
- N7. Receive the 3031 and its associated hardware from the factory.
 IBM 9/3/79
- N8. Unpack the new equipment and set up the 3031 and its new components offline. Run preliminary tests.
 IBM 9/5/79
- N9. Install 38302 and CDC disk system on the 370/148.
 CDC 8/7/79
- N10. Inform IBM of production shutdown on 370/148.
 Garmoe $\frac{1}{2}$ man day 9/6/79
- N11. Attach all peripherals to the 3031 and check them out.
 IBM 9/7/79
- N12. Bring up VM and test it with the IVP (Installation Verification Program).
 Garmoe 1 man day 9/9/79

N13. Test 3705 Emulator Program System and test 3705 loading and operating features.

| | | |
|--------|-----------|--------|
| Garmoe | 1 man day | 9/9/79 |
|--------|-----------|--------|

N14. Test RSCS with JSC.

| | | |
|--------|-----------|--------|
| Garmoe | 1 man day | 9/9/79 |
|--------|-----------|--------|

N15. Run acceptance test and test code for 3286 hardcopy of console log.

| | | |
|-------------------|-----------|--------|
| Garmoe and others | 1 man day | 9/9/79 |
|-------------------|-----------|--------|

N16. Rerun systems software tests; also run accounting and directory tests.

| | | |
|---------|------------|--------|
| Garmoe | | |
| Collins | 2 man days | 9/9/79 |

N17. Rerun CPU Strain Test.

| | | |
|--------------------|-----------|---------|
| Shelley and others | 1 man day | 9/10/79 |
|--------------------|-----------|---------|

N18. Rerun Standard Mix Tests.

| | | |
|---------|-----------|---------|
| Shelley | | |
| JSC | 1 man day | 9/10/79 |

N19. Rerun Paging Strain Test.

| | | |
|---------|-----------|---------|
| Shelley | 1 man day | 9/10/79 |
|---------|-----------|---------|

N20. Rerun rate establishment tests.

| | | |
|--------------------|-----------|---------|
| Shelley and others | 1 man day | 9/10/79 |
|--------------------|-----------|---------|

N21. Provide operators with hands-on experience in the power-up, power-down and operation of the 3031.

| | | |
|----------|-------------|---------|
| Collins. | 10 man days | 9/10/79 |
|----------|-------------|---------|

N22. Obtain practical experience in controlling and operating the 3031 for computer operators.

| | | |
|---------|------------|---------|
| Collins | 4 man days | 9/10/79 |
|---------|------------|---------|

N23. Inform IBM so that they can remove 370/148 equipment.

| | | |
|--------|-----------|---------|
| Garmoe | 1 man day | 9/10/79 |
|--------|-----------|---------|

N24. Upon removal of the 148, complete the physical layout of the computer room.

| | | |
|---------|------------|---------|
| Collins | 4 man days | 10/1/79 |
|---------|------------|---------|

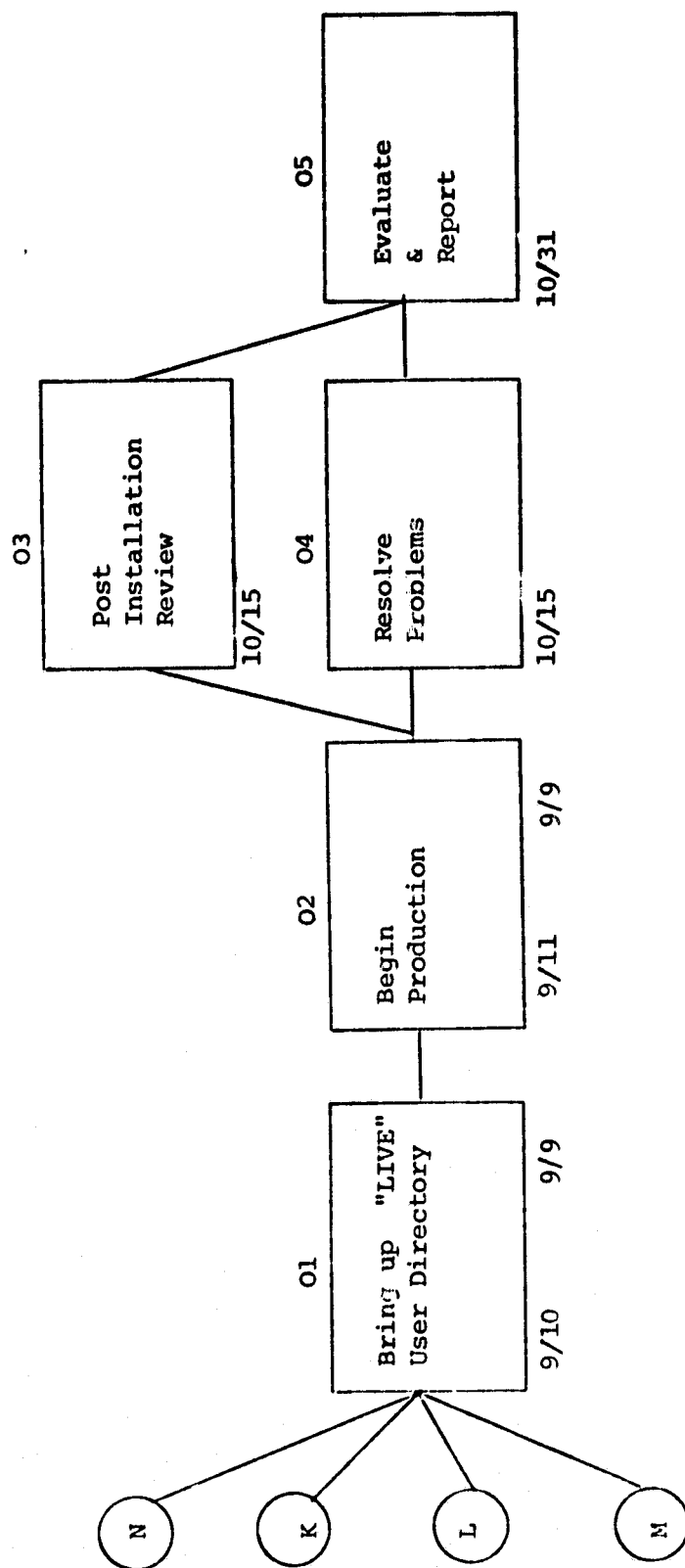


Figure O: Production & Evaluation

O. Production & Evaluation

- 01 Bring up and establish "live" user directory needed to support all users of the LARS system

M. Collins 1 man days 9/10/79

- 02 Begin regular production with 3031.

R. Garmoe 2 man days 9/11/79

- 04 Continue to resolve any "problems" and "loose ends".

R. Garmoe 10 man days 10/15/79

- 03 Conduct post-installation review meeting and review task leader evaluation reports. (Kast, Phillips, Garmoe, Collins)

J. Kast 6 man days 10/15/79

- 05 Evaluate the installation process and report.

T. Phillips 3 man days 10/31/79

Task O Total

Kast 22 man days October 31

C-2

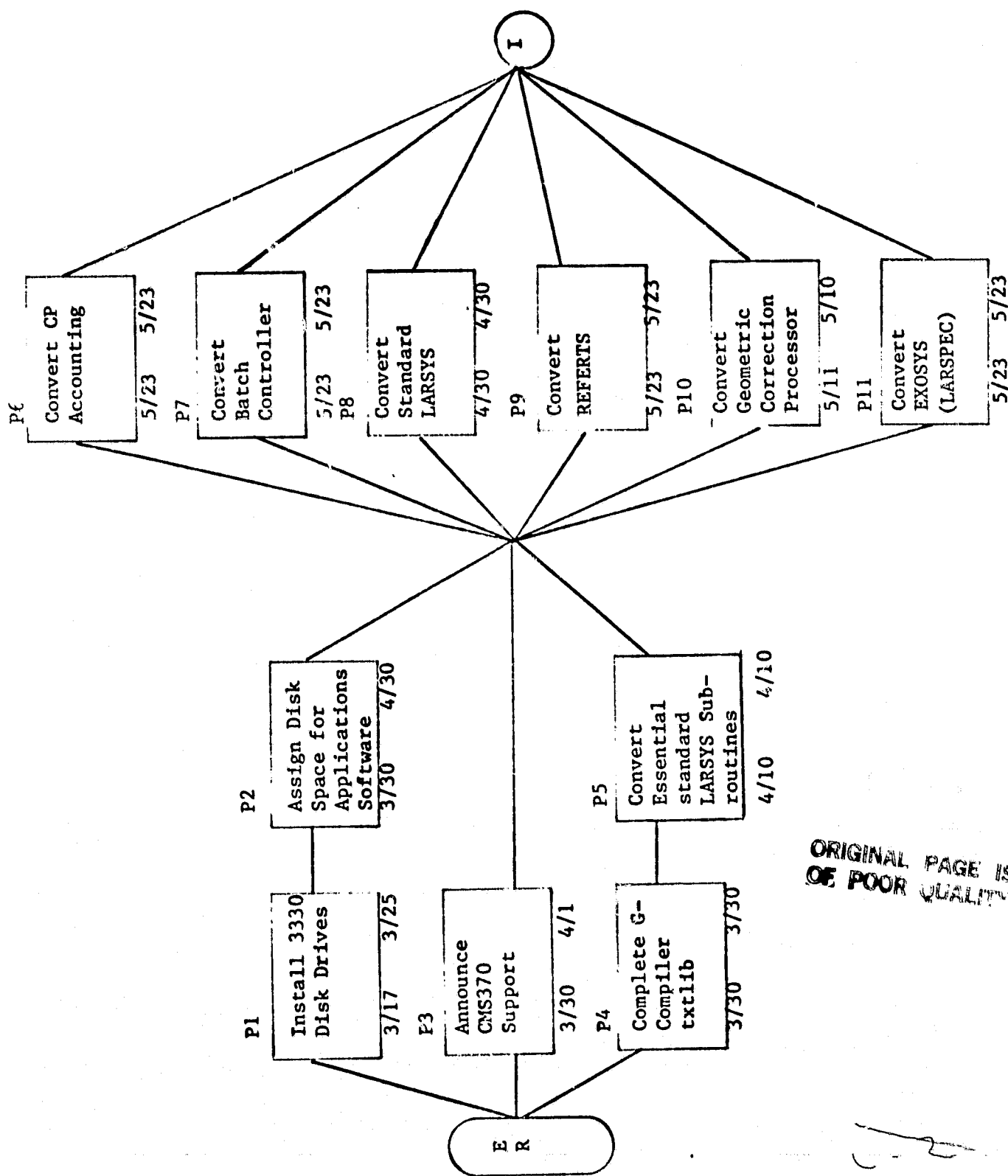


Figure P: CMS370 Software Conversion for 3031 Test

P. CMS370 Application Software Conversion

- P1. Install 3330 disk drives. This must be done in order to have all needed disk space available for converting to CMS370.
- | | | |
|---------|-------------|------|
| Garmoe | 10 man days | |
| Collins | 3 man days | |
| Philipp | 2 man days | 3/25 |
- P2. Assign disk space for all application systems. Make list of needs and update directory.
- | | | |
|-----------|-----------|------|
| Etheridge | 1 man day | |
| Collins | 1 man day | 3/30 |
- P3. Announce CMS370 support. Write up item for SCANLINES.
- | | | |
|--------|-----------|------|
| Garmoe | 1 man day | 3/30 |
|--------|-----------|------|
- P4. Complete G-compiler txtlib. Some special CMS routines are needed, mainly for computer facility users, in the G-compiler FORTRAN txtlib on the CMS370 disk.
- | | | |
|---------|------------|------|
| Philipp | 5 man days | |
| Wilson | 5 man days | 3/30 |
- P5. Convert essential standard LARSYS routines. TAPOP is the only outstanding one. A couple of last changes have to be made, and documentation completed.
- | | | |
|---------|------------|------|
| Shelley | 3 man days | 4/10 |
|---------|------------|------|
- P6. Convert CP accounting. The programs are being tested now. The BACKUP routine has to wait for completion of standard LARSYS (See Box I8).
- | | | |
|-----------|------------|------|
| Garmoe | 3 man days | |
| Etheridge | 1 man day | |
| Pauley | 6 man days | 5/23 |
- P7. Convert Batch controller. We have 370 batch machines but ID BATCH, the controller, still runs on CMS360. The programs are converted but not tested (Steve Pauley converted them). Tested in Box I8.
- | | | |
|-----------|-------------|------|
| Etheridge | 4 man days | |
| Kraemer | 10 man days | |
| Pauley | 6 man days | 5/23 |
- P8. Convert standard LARSYS. PHOTO, TAPUTL and a handful of minor routines need to be converted. The 18 standard processors are up and running.
- | | | |
|---------------|------------|------|
| Etheridge | 4 man days | |
| Shelley | 2 man days | |
| Schwingendorf | 4 man days | 4/30 |

P9. Convert REFERTS to be tested in Box I8.

Kozlowski

3 man days

5/23

P10. Convert the Geometric Correction Processor in preparation for testing under Box I6.

Kozlowski

4 man days

5/11

P11. Convert EXOSYS. Steps that have been done: divorce EXOSYS from the Reform disk, get rid of need for old EXOSYS and just have EXOSYSDV (as EXOSYS). GCS txtlibs for CMS370 will be put on the EXOSYS disk until another decision is made after 3031 installation. Tested in Box I8.

Etheridge

4 man days

Heinrich

6 man days

5/23

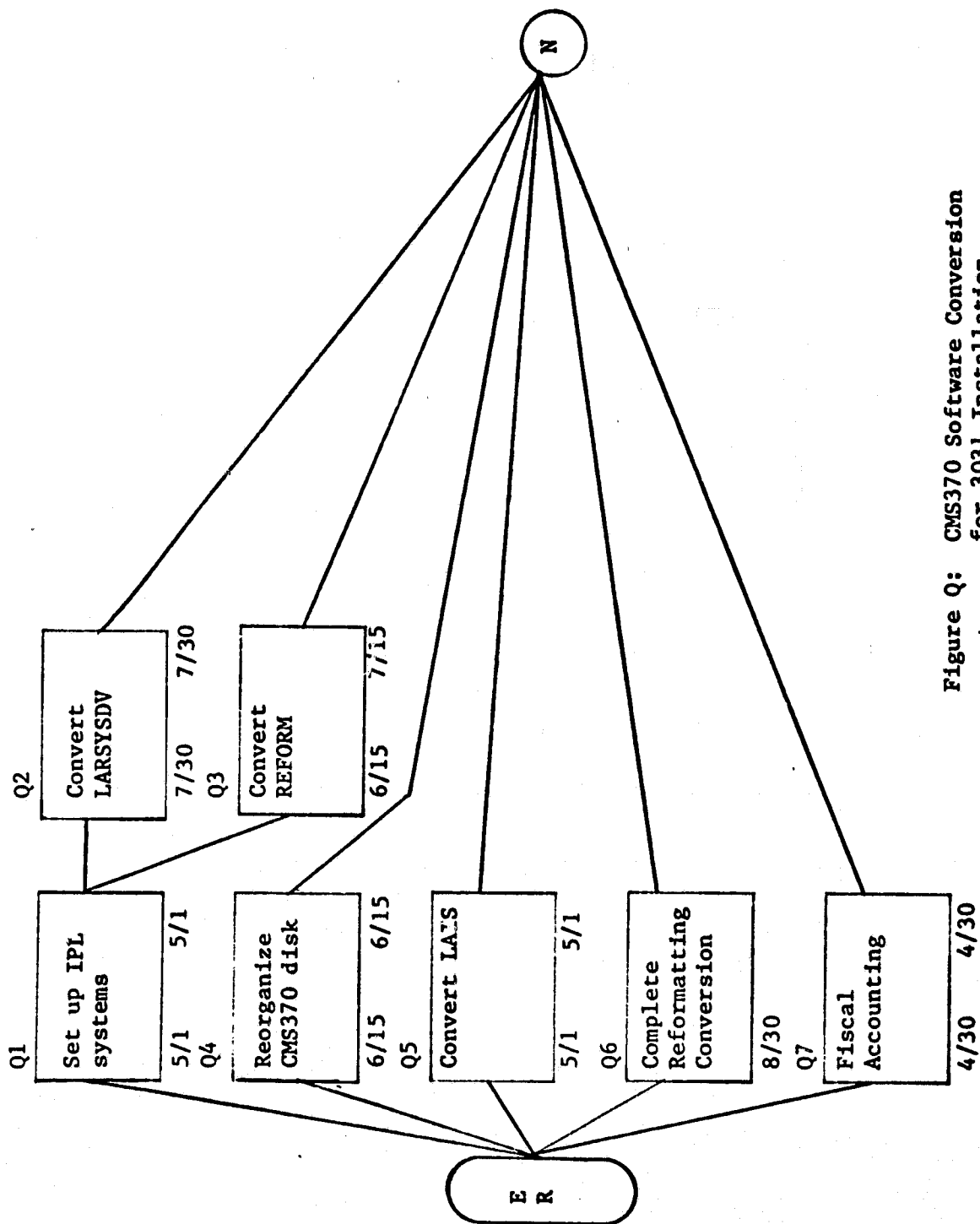


Figure Q: CMS370 Software Conversion
for 3031 Installation

Q. CMS370 Conversion for 3031 Installation

- Q1. Set up CP hooks for IPLing LARSYSDV and Reform under CMS370.
 Garmoe 2 man days 5/1
- Q2. Convert LARSYSDV to CMS370.
 Shelley 4 man days
 Etheridge 3 man days
 Lang 6 man days 7/30
- Q3. Convert Reform IPL system to CMS370.
 Kozlowski 6 man days 6/15
- Q4. Reorganize CMS370 systems disk, and establish specialized systems disks for PLTLIB and SPSSLIB as read-only extensions.
 Etheridge 2 man days
 Philipp 3 man days
 Wilson 2 man days 5/15
- Q5. Complete the conversion of LAIS and begin operational use under CMS370.
 Graham 20 man days 5/1
- Q6. Complete conversion of reformatting, accounting, tapehandler, registration system, color product processing system, etc.
 Kozlowski 15 man days
 Smith 10 man days
 Murphy 3 man days 8/30
- Q7. Complete conversion of the Fiscal Accounting System.
 Etheridge 5 man days 4/30

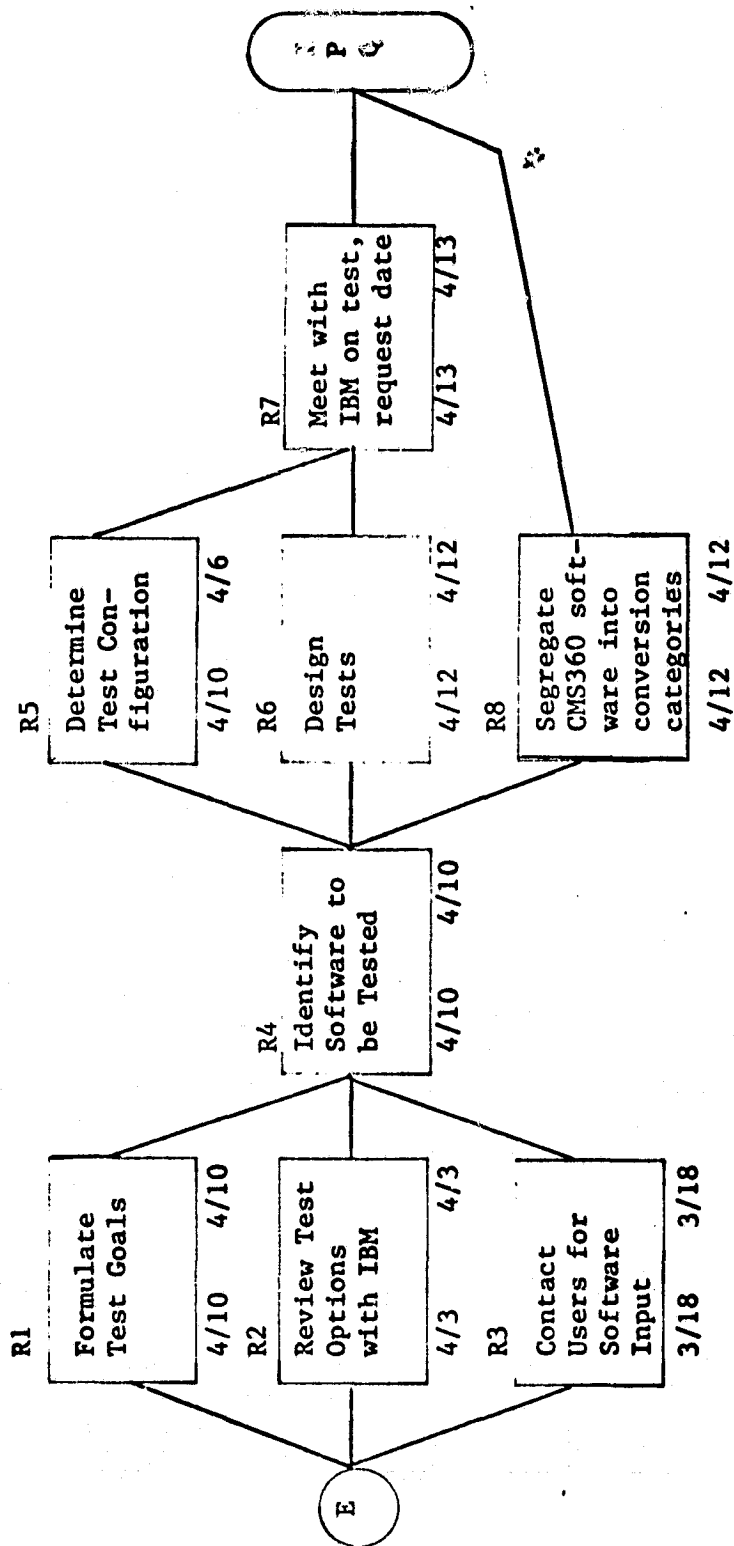


Figure R: Prepare for Software Testing

APPENDIX B
RELATIVE CAPACITIES OF THE LARS 370/148 and
3031 COMPUTER CONFIGURATIONS -- PRELIMINARY FINDINGS

APPENDIX B

RELATIVE CAPACITIES OF THE LARS 370/148 and
3031 COMPUTER CONFIGURATIONS -- PRELIMINARY FINDINGS
by Peter Jobusch

For capacity measurement purposes, we regard a computer system as a three dimensional object. The three axes are CPU power, main storage capacity, and I/O subsystem capacity. We have expanded in two of the three dimensions with the installation of the 3031 system. Specifically, the CPU power has about tripled and the main storage available to users has expanded from 160 to 416 pages (a factor of 2.6). The capacity of the I/O subsystem, while unchanged, is now more available for user I/O because paging has been virtually eliminated.

The 3031 system is clearly performing much better than the previous 370/148 configuration. It is performing so well, in fact, that we have experienced a drop in the number of active users as people get their work done and can log off the system (see Figure 1). It remains to be seen how much more work the 3031 can perform. Extrapolation from current levels of use to estimate the maximum number of users the system could support is risky for two reasons. First, the present level of use is low relative to system capacity. Second, the relationship between the number of active users and the service levels provided are non-linear due to queuing effects. This non-linear effect can be seen most clearly in Figure 2 which shows a dramatic reduction in service levels provided by the 370/148 system as the active user load increased beyond ten.

Utilization of the three dimensions of the computer system is shown in Figures 3, 4, and 5. Judging from these graphs, and their implied functional relationships, we estimate that the 3031 system can adequately support between 20 and 25 active users and still provide an overall level of service (as measured by the resource availability index) of about .8.

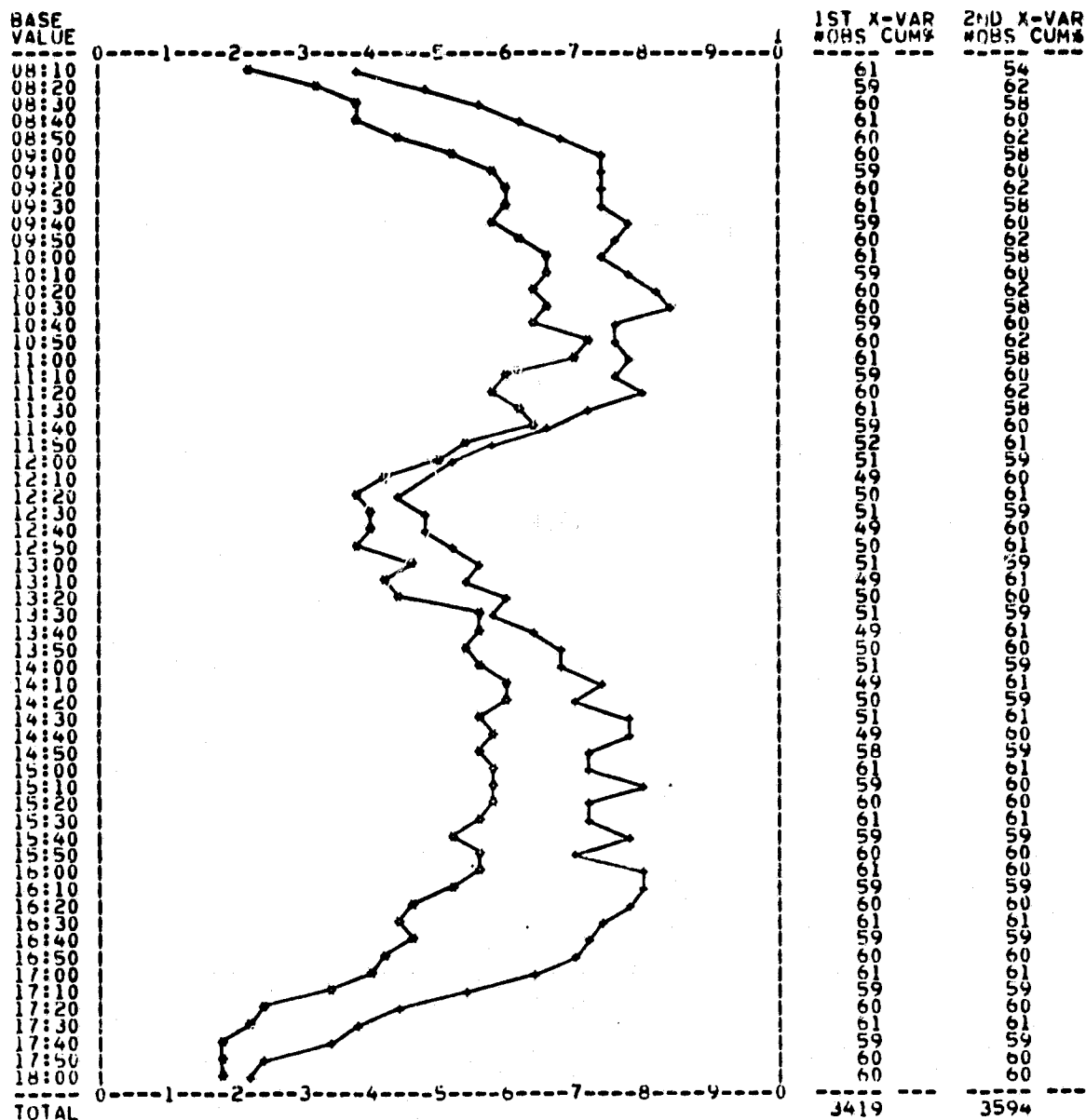
This conclusion is drawn from data gathered during the first two weeks of 3031 use. As more data are analyzed and more experience gained with the system, it will be refined.

09/18/79 09/04/79 FIGURE 1 - PLOT OF ACTIVE USERS VERSUS TIME OF DAY

BASE VARIABLE - TOD

TIME OF DAY

| SYM | CROSS-VAR | SCALE | ORG | AVG | MAX | DESCRIPTION |
|-----|-----------|-------|-----|-------|-------|------------------|
| * | ACTIVE | 2.00 | | 5.67 | 24.00 | VALUES FROM 3031 |
| . | ACTIVE | 2.00 | | 13.15 | 31.00 | VALUES FROM 148 |

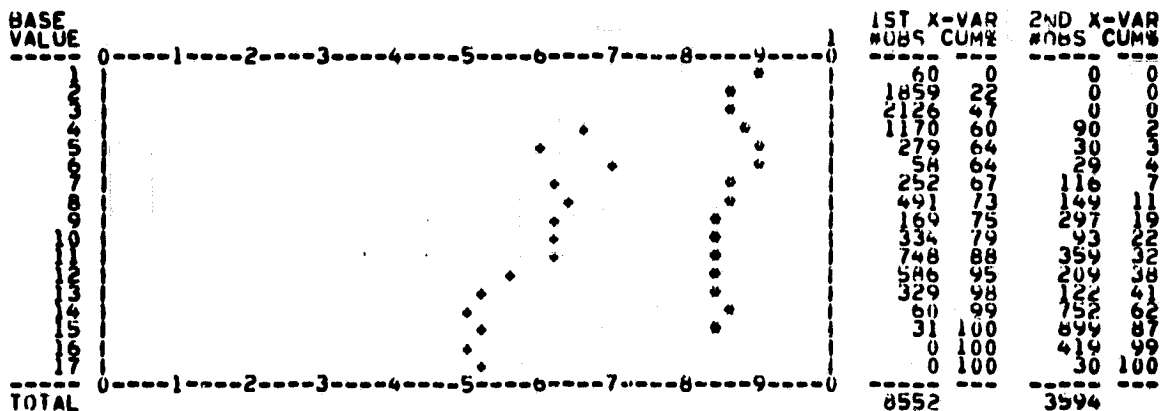


09/18/79 09/04/79 FIGURE 2 - RESOURCE AVAILABILITY INDEX (RAI)
VERSUS NUMBER OF ACTIVE USERS

BASE VARIABLE - ACTIVE

USERS ACTIVE IN A SAMPLE INTERVAL

| SYM | CROSS-VAR | SCALE | ORG | AVG | MAX | DESCRIPTION |
|-------|-----------|-------|-----|------|------|------------------|
| * RAI | | 0.10 | | 0.67 | 1.00 | VALUES FROM 3031 |
| * RAI | | 0.10 | | 0.55 | 1.00 | VALUES FROM 148 |

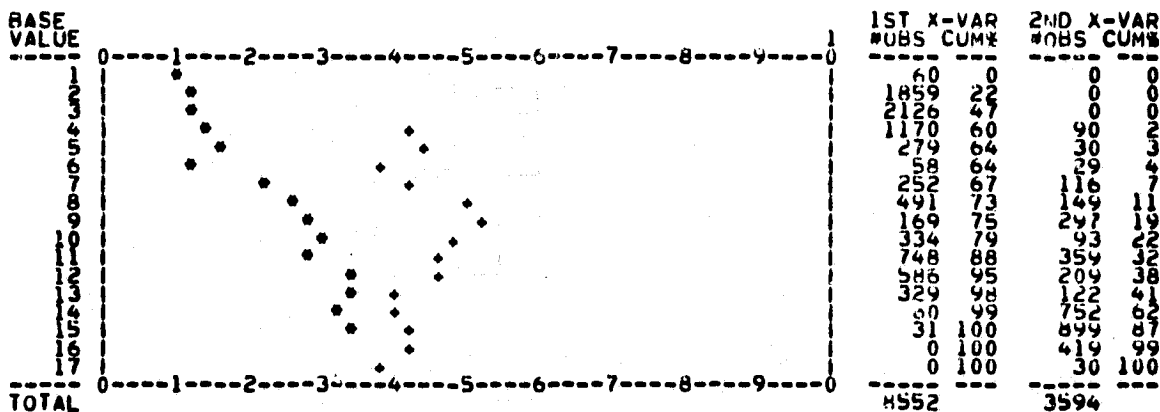


09/18/79 09/04/79 FIGURE 3 - PLOT OF VIRTUAL MACHINE CPU UTILIZATION
VERSUS NUMBER OF ACTIVE USERS

BASE VARIABLE - ACTIVE

USERS ACTIVE IN A SAMPLE INTERVAL

| SYM | CROSS-VAR | SCALE | ORG | AVG | MAX | DESCRIPTION |
|-----------|-----------|-------|-----|-------|-------|------------------|
| * VIRTCPU | | 10.00 | | 20.70 | 99.16 | VALUES FROM 3031 |
| * VIRTCPU | | 10.00 | | 44.55 | 97.24 | VALUES FROM 148 |



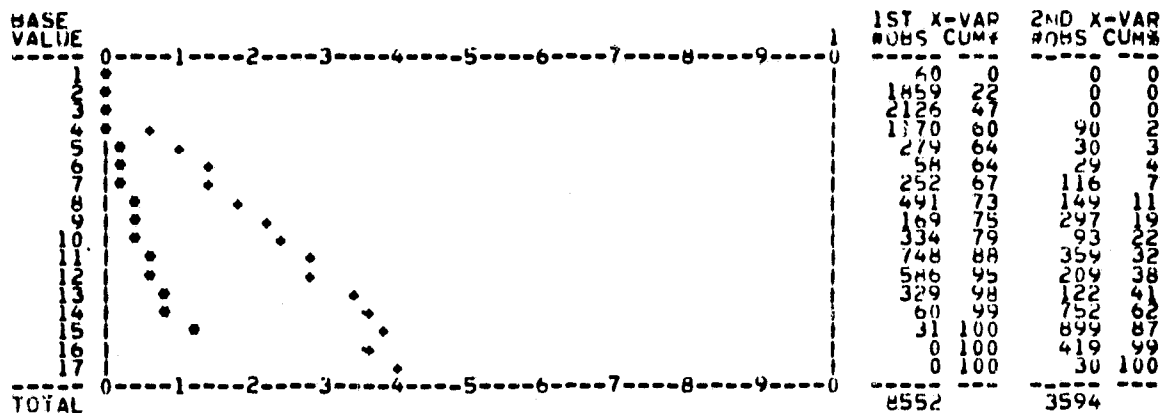
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OF PAGE

09/18/79 09/04/79 FIGURE 4 - TOTAL SYSTEM PAGING PER SECOND
VERSUS NUMBER OF ACTIVE USERS

BASE VARIABLE - ACTIVE

USEPS ACTIVE IN A SAMPLE INTERVAL

| SYM | CROSS-VAR | SCALE | ORG | AVG | MAX | DESCRIPTION |
|-----|-----------|-------|-----|-------|-------|------------------|
| * | PAGERATE | 10.00 | | 2.46 | 47.57 | VALUES FROM 3031 |
| * | PAGERATE | 10.00 | | 31.85 | 71.05 | VALUES FROM 148 |

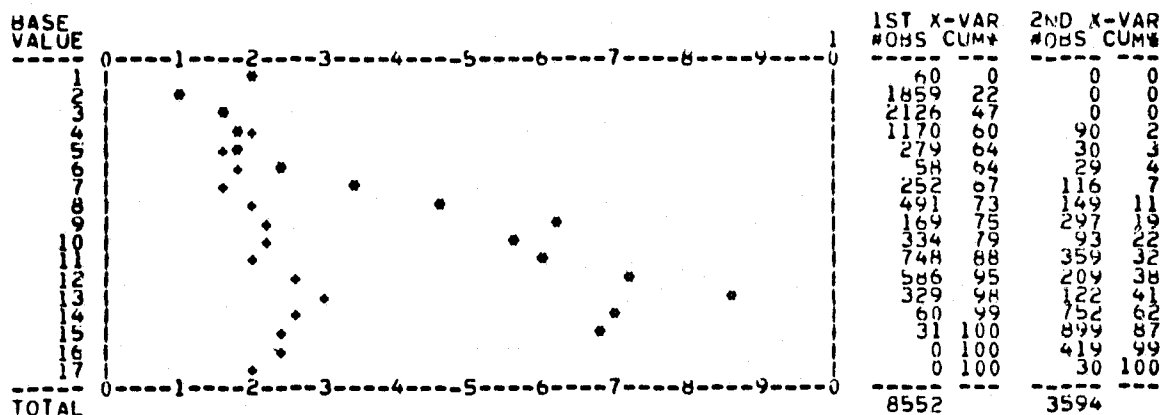


09/18/79 09/04/79 FIGURE 5 - PLOT OF VIRTUAL MACHINE I/O RATE
VERSUS NUMBER OF ACTIVE USERS

BASE VARIABLE - ACTIVE

USERS ACTIVE IN A SAMPLE INTERVAL

| SYM | CROSS-VAR | SCALE | ORG | AVG | MAX | DESCRIPTION |
|-----|-----------|-------|-----|-------|---------|------------------|
| * | VIO | 10.00 | | 28.50 | 3303.39 | VALUES FROM 3031 |
| * | VIO | 10.00 | | 24.41 | 327.47 | VALUES FROM 148 |



APPENDIX C
RT&E DATA BASE

SEGMENT CATALOG

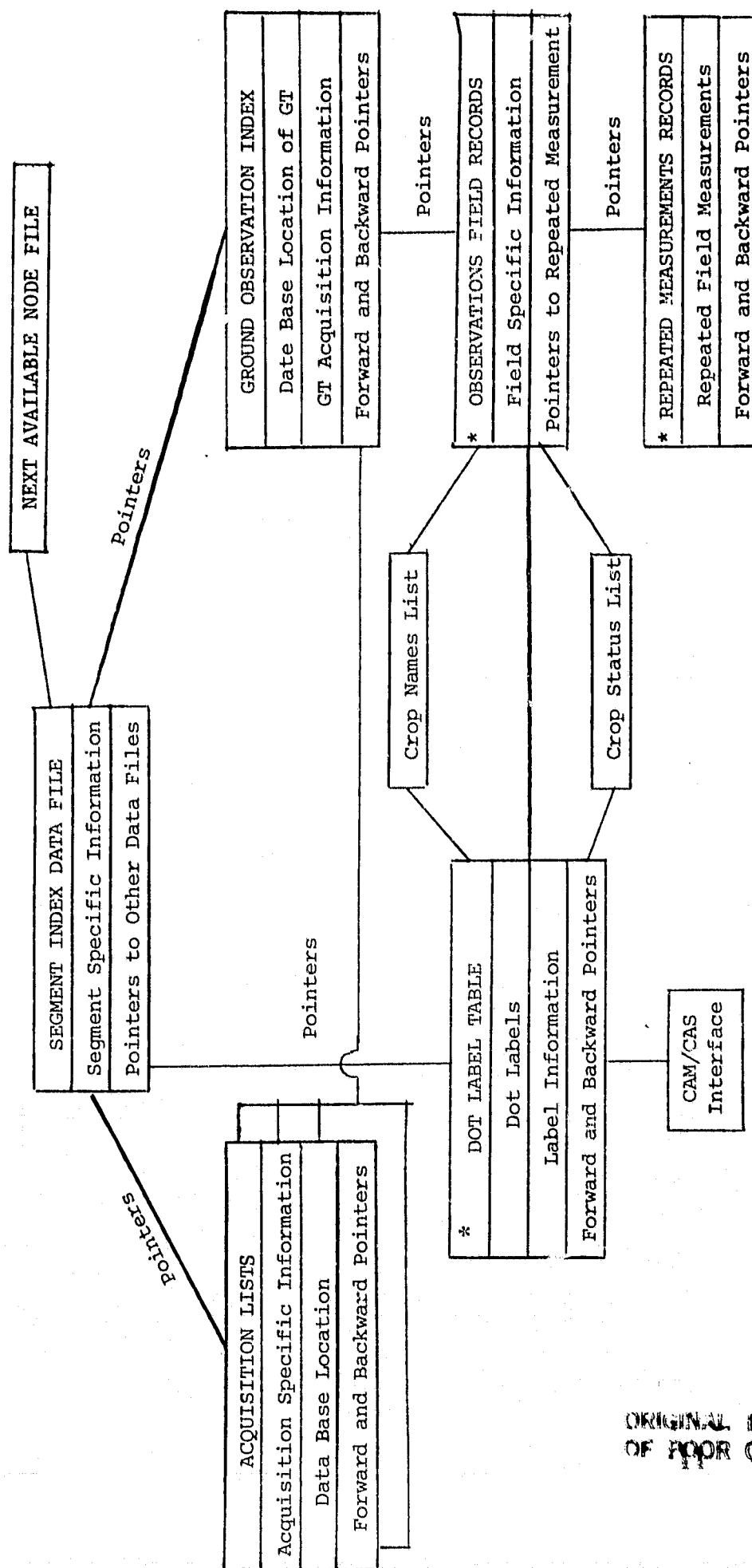


Figure A

*Not implemented

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OF POOR QUALITY

Format of Next Node File

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|---|---------------|--------------|
| Number of Segment Index Records | I*6 | 1-6 |
| Next Available Acquisition List Record | I*6 | 7-12 |
| Number of Dot Label Records | I*6 | 13-18 |
| Number of Crop Names | I*6 | 19-24 |
| Number of Crop Status Records | I*6 | 25-30 |
| Number of Ground Observation Records | I*6 | 31-36 |
| Number of Observations Field Records | I*6 | 37-42 |
| Number of Repeated Measurements Records | I*6 | 43-48 |
| Number of Acquisitions | I*6 | 49-54 |
| Unused | | 56-80 |

Note: This file contains only one record. The Next Available Acquisition List Record pointer is actually the head of a linked list of available Acquisition Records. These free nodes are connected through the Next Acquisition data item found in the Acquisition List.

Format of Segment Index Records

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|---|---------------|--------------|
| Date Segment Initiated (YYDDD) | I*4 | 1-4 |
| Segment Descriptor (county, state, other) | 8A4 | 5-36 |
| Acquisition List Pointer: First Entry | I*4 | 37-40 |
| Last Entry | I*4 | 41-44 |
| Label Index Pointer: First Entry | I*4 | 45-48 |
| Last Entry | I*4 | 49-52 |
| Ground Observation Index: First Entry | I*4 | 53-56 |
| Last Entry | I*4 | 57-60 |
| Segment Number | I*2 | 61-62 |
| Segment Center Latitude (minutes north) | I*2 | 63-64 |
| Segment Longitude (minutes east) | I*2 | 65-66 |
| Country (number coded) | I*2 | 67-68 |
| State (number coded) | I*2 | 69-70 |
| County (number coded) | I*2 | 71-72 |
| Agro-Physical Unit | I*2 | 73-74 |
| Crop Reporting District | I*2 | 75-76 |
| File Pointer for First Acquisition | L*1 | 77 |
| File Pointer for Last Acquisition | L*1 | 78 |
| Unused | | 79-80 |

Format of Acquisition List Records

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|---------------------------------------|---------------|--------------|
| Sensor System | A8 | 1-8 |
| Previous Acquisition | I*4 | 9-12 |
| Next Acquisition | I*4 | 13-16 |
| Orbit Number | I*4 | 17-20 |
| Scene Frame ID (SFI) | I*4 | 21-24 |
| Reference SFI | I*4 | 25-28 |
| Reference SFI for Ground Observations | I*4 | 29-32 |
| Date Data Collected (YYDDD) | I*4 | 33-36 |
| Time Data Collected (GMT) | I*4 | 37-40 |
| Date Entered In (YYDDD) | I*4 | 41-44 |
| Goddard Processing Date | I*4 | 45-48 |
| Date of Unload Tape | I*4 | 49-52 |
| Peak Sharpness | R*4 | 53-56 |
| Normalized Peak to Background Ratio | R*4 | 57-60 |
| Segment Number | I*2 | 61-62 |
| Sun Elevation (min.) | I*2 | 63-64 |
| Sun Azimuth (min.) | I*2 | 65-66 |
| Tape Number | I*2 | 67-68 |
| Lines of Data | I*2 | 69-70 |
| Columns of Data | I*2 | 71-72 |
| PFC Bias for Channel 1 | I*2 | 73-74 |
| PFC Bias for Channel 2 | I*2 | 75-76 |
| PFC Bias for Channel 3 | I*2 | 77-78 |
| PFC Bias for Channel 4 | I*2 | 79-80 |
| PFC Gain for Channel 1 | I*2 | 81-82 |
| PFC Gain for Channel 2 | I*2 | 83-84 |
| PFC Gain for Channel 3 | I*2 | 85-86 |
| PFC Gain for Channel 4 | I*2 | 87-88 |
| Cloud Cover | L*1 | 89 |
| Processing Flag | L*1 | 90 |
| Greenness of Soil Line | L*1 | 91 |
| XSTAR Haze Parameter | L*1 | 92 |

Format of Acquisition List Records

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|---------------------------------------|---------------|--------------|
| File Number | L*1 | 93 |
| First Channel | L*1 | 94 |
| Last Channel (NC) | L*1 | 95 |
| Crop Year Designator | L*1 | 96 |
| Landsat Number | L*1 | 97 |
| Data Classification | L*1 | 98 |
| File Pointer for Previous Acquisition | L*1 | 99 |
| File pointer for Next Acquisition | L*1 | 100 |
| Unused | | 101-120 |

Format of Dot Label Table Records

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|--|---------------|--------------|
| Previous Label Entry | I*4 | 1-4 |
| Next Label Entry | I*4 | 5-8 |
| Segment Number | I*2 | 9-10 |
| Analyst Identifier | L*1 | 11 |
| Number of Categories | L*1 | 12 |
| Labelling Convention | I*2 | 13-14 |
| Experiment | I*2 | 15-16 |
| Date of Labelling (YYDDD) | I*4 | 17-20 |
| Acquisitions Used in Labelling | | |
| Date #1 (YYDDD) | I*4 | 21-24 |
| Date #2 (YYDDD) | I*4 | 25-28 |
| : | | |
| : | | |
| Date #8 (YYDDD) | I*4 | 39-52 |
| Category Names | | |
| Crop Annotated as Category 1 | I*2 | 53-54 |
| Crop Annotated as Category 2 | I*2 | 55-56 |
| Blank fill or Crop Annotated Category 3 | I*2 | 57-58 |
| : | | |
| Blank fill or Crop Annotated Category 30 | I*2 | 111-112 |
| Pointer to First Test Field | I*4 | 113-116 |
| Pointer to Last Test Field | I*4 | 117-120 |
| Pointer to First DO/DU Field | I*4 | 121-124 |
| Pointer to Last DO/DU Field | I*4 | 125-128 |
| CAM/CAS Tape Number | I*2 | 129-130 |
| CAM/CAS File Number | I*4 | 131-132 |
| Number of Labels (NC) | I*2 | 133-134 |
| Labels and Annotation | | |
| Labelled Line for Dot 1 | I*2 | 135-136 |
| Labelled Column for Dot 1 | I*2 | 137-138 |
| *Dot Label for Dot 1 | I*2 | 139-140 |
| **Dot Annotation for Dot 1 | L*1 | 141 |

Format of Dot Label Table Records

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|-----------------------------|---------------|-------------------|
| Dot Status for Dot 1 | L*1 | 142 |
| ⋮ | | |
| Labelled Line for Dot NC | I*2 | 127+8*NC-128+8*NC |
| Labelled Column for Dot NC | I*2 | 129+8*NC-130+8*NC |
| *Dot Label for Dot NC | I*2 | 131+8*NC-132+8*NC |
| **Dot Annotation for Dot NC | L*1 | 133+8*NC |
| Dot Status for Dot NC | L*1 | 134+8*NC |

* 1 - N - 30 == Type one dot corresponding to category name N

** 129 - N - 158 ==Type two dot corresponding to category name N-128

** 0 == A Field Pixel

1 == Dot in DO Area

2 == Dot in DU Area

3 == Dot is an edge pixel

4 == Dot is a boundard pixel

Crop Name List

| <u>Entry</u> | <u>Format</u> | <u>Byte</u> |
|---------------------|---------------|-------------|
| Name for Label 1 | A8 | 1-8 |
| Variety for Label 1 | A8 | 9-16 |
| Name for Label 2 | A8 | 17-24 |
| Variety for Label 2 | A8 | 25-32 |
| ⋮ | | ⋮ |

Crop Status List

| <u>Entry</u> | <u>Format</u> | <u>Byte</u> |
|------------------|---------------|-------------|
| Name of Status 1 | A8 | 1-8 |
| Name of Status 2 | A8 | 9-16 |
| ⋮ | | ⋮ |

Ground Observations Table
Ground Observations Index

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|---|---------------|--------------|
| Previous Ground Truth Entry | I*4 | 1-4 |
| Next Ground Truth Entry | I*4 | 5-8 |
| Segment Number | I*2 | 9-10 |
| Number of Fields Monitored for Agronomic Data | I*2 | 11-12 |
| Date of Initial GT Record (YYDDD) | I*4 | 13-16 |
| Date of GT Reference (YYDDD) | I*4 | 17-20 |
| Pointer to Acquisition List for first W to W GT | I*4 | 21-24 |
| Pointer to Acquisition List for last W to W GT | I*4 | 25-28 |
| Pointer to first Monitored Field | I*4 | 29-32 |
| Pointer to last Monitored Field | I*4 | 33-36 |
| Crop Year Designator | L*1 | 37 |
| File Pointer for first Acquisition | L*1 | 38 |
| File Pointer for last Acquisition | L*1 | 39 |
| Unused | | 40-50 |

Observation Field Records

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|--|---------------|---------------------|
| Previous Field Monitored | I*4 | 1-4 |
| Next Field Monitored | I*4 | 5-8 |
| Segment Number | I*2 | 9-10 |
| Field Number | I*2 | 11-12 |
| Field Identifier | A8 | 13-20 |
| Crop Names Entry | I*2 | 21-22 |
| Crop Status Entry | I*2 | 23-24 |
| Date Planted (YYDDD) | I*2 | 25-26 |
| Nitrogen Fertilization | I*2 | 27-28 |
| Row Width (meters) | R*4 | 29-32 |
| Pointer to first of Repeated Measures Data | I*4 | 33-36 |
| Pointer to last of Repeated Measures Data | I*4 | 37-40 |
| Number of ARCS (NARC) | I*2 | 41-42 |
| Line Coordinate 1 | I*2 | 43-44 |
| Column Coordinate 1 | I*2 | 45-46 |
| Line Coordinate 2 | I*2 | 47-48 |
| Column Coordinate 2 | I*2 | 49-50 |
| ⋮ | | |
| Line Coordinate NARC | I*2 | 39+NARC*4-40+NARC*4 |
| Column Coordinate NARC | I*2 | 41+NARC*4-42-NARC*4 |

Repeated Measurement Record

| <u>Entry</u> | <u>Format</u> | <u>Bytes</u> |
|-----------------------|---------------|--------------|
| Previous Measurement | I*4 | 1-4 |
| Next Measurement | I*4 | 5-8 |
| Segment Number | I*2 | 9-10 |
| Field Number | I*2 | 11-12 |
| Date Measured (YYDDD) | I*4 | 13-16 |
| Maturity | L*1 | 17 |
| % of Ground Cover | I*1 | 18 |
| % of Green Leaves | L*1 | 19 |
| Condition | L*1 | 20 |

APPENDIX D
CHANGES TO RT&E DATA BASE SOFTWARE

APPENDIX D

CHANGES TO RT&E DATA BASE SOFTWARE

A new version of the RT&E data base was made available Monday, August 27th. For two weeks following that date, both the old and new versions were available. Afterward, the old version was removed.

The new version of the data base and its accompanying software can be accessed in the same way as the old. The software is located on JSCDISK 19A, which must be accessed as a B-disk. There have been a few changes, however. The software for the new version can be accessed by loading the text files 'SEGFO2', 'GTINFO2', 'GETACQ2' and/or 'RTEERR', depending on the subroutine(s) desired. When using the new versions of SEGFO and GTINFO, you need no longer make any special FILEDEFS.

SUBROUTINES SEGFO AND GTINFO

CALL SEGFO (SEGNUM, ACQCNT, ACQ. INDEX, ERROR, DEVICE)

CALL GTINFO (SEGNUM, ACQCNT, ACQ, INDEX, ERROR, DEVICE)

Both of these subroutines now have an additional input argument. It is 'DEVICE,' and INTEGER*4 variable used to pass to the subroutine a data set reference number that the subroutine will use to access the files of the data base (this parameter takes the place of the previously-needed FILEDEFS.) When writing programs that use these subroutines, you should pass each subroutine a unique DEVICE number that is used for no other purpose. Also, the routines no longer write out error messages: they simply return an appropriate value in the 'ERROR' parameter. An informative message can still be obtained by calling the new subroutine 'RTEERR', which is described further below.

SUBROUTINE GETACQ

CALL GETACQ (UNIT, SEGNUM, ACQ, ERROR, DEVICE)

GETACQ, like SEGFO and GTINFO, also requires that the final parameter in the call be DEVICE. This variable serves the same function as the one used in SEGFO; therefore, follow the same rules stated above. GETACQ also no longer prints out error messages, but the messages can be displayed by calling RTEERR.

NEW SUBROUTINE RTEERR

CALL RTEERR (E, DEVICE)

Usage Notes: If an error message is desired, call RTEERR immediately after the call to the routine in which the error may have taken place (either SEGFO, GTINFO, or GETACQ). You must pass as argument 'E' the variable which contains the return code from the routine in question, and as 'DEVICE' you must pass the data set reference number of the device on which you wish the error message to appear. Please note: the 'DEVICE' must be previously defined with a FILEDEF command.

FORTTRAN-H versions of the RT&E Data Base Software will be formally introduced to the JSC users during the LARS CMS Short Course in December. The software for these versions can be accessed by loading the text files 'SEGFOHX', 'GTINFOHX', 'GETACQHX', and/or 'RTEERRHX'. These texts are stored on the JSCDISK 19A. The new software though, unlike the FORTTRAN-G versions, does not require that this disk be accessed as a B-disk. A new argument 'MODE', an INTEGER*2 variable, must now be passed to SEGFO, GTINFO, and GETACQ. MODE must follow the parameter DEVICE in the three calls, and in all cases, indicates how the JSCDISK 19A was accessed. For example, if the following command was issued in CMS370:

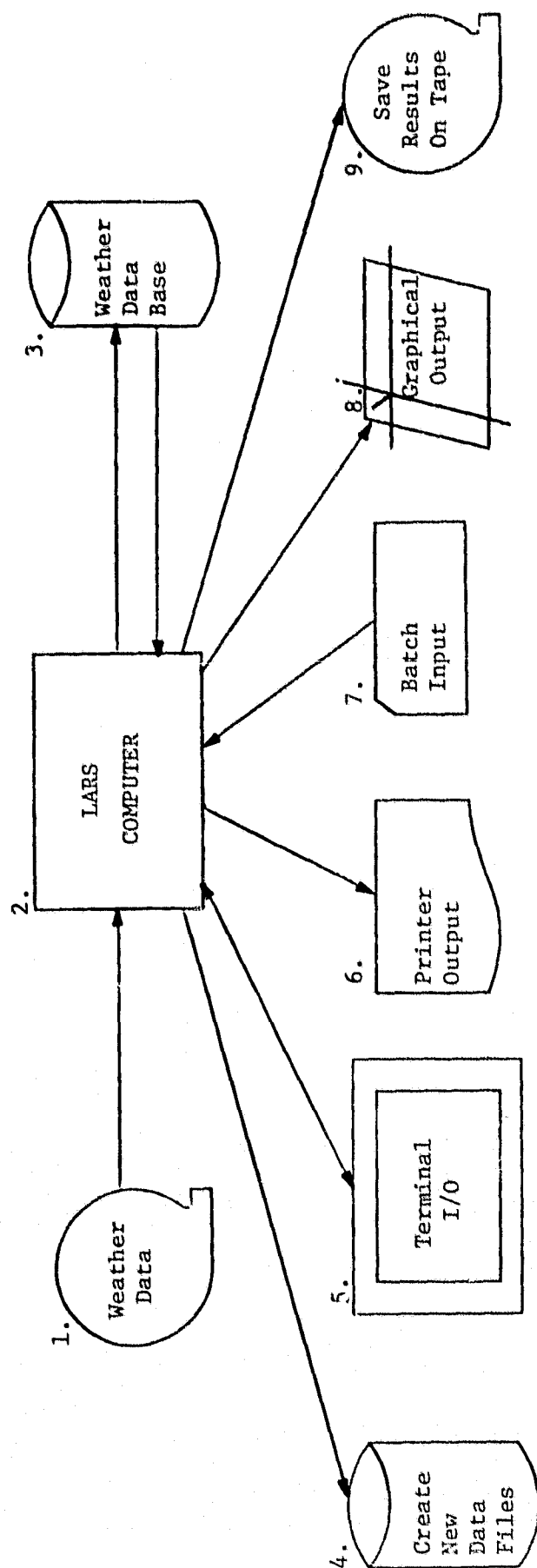
GETDISK JSCDISK 19A C

MODE must then be set to the character string 'C1'. The first character always signals the RT&E software how the disk was accessed and the second character must always be a one.

A FORTTRAN-H version of SUBSET, the data base inquiry software, will also be announced in December. Major modifications have been included in this new version will be discussed thoroughly during the Short Course.

APPENDIX E
DESIGN CONSIDERATION FOR NOAA WEATHER DATA BASE

NOAA Weather Data Base System



1. A tape with weather data covering the last 14 days is sent to LARS.
2. The LARS computer then processes the data, stores it on disk, and makes it available to various I/O devices.
3. The data base is saved on a disk for high speed access. Data for the past 18 months is stored.
4. Files of subsets of the data base can be created.
5. A terminal can interactively query the data base.
6. Output can be printed on the line printer.
7. Batch jobs will be able to access the data base.
8. Graphical output can be generated by devices with line drawing capabilities.
9. Copies of data and/or results can be stored on tape for future use.

NOAA Weather Data Base File Structure

Regional Daily Data File for Past 546 Days

| Record | Data Item | Format | Bytes |
|--------|---|--------|----------|
| 1 | Maximum Temperature | 546I*2 | 1-1092 |
| 2 | Minimum Temperature | 546I*2 | 1-1092 |
| 3 | Maximum Temperature Flag | 546L*1 | 1-546 |
| 3 | Minimum Temperature Flag | 546L*1 | 547-1092 |
| 4 | Precipitation | 546I*2 | 1-1092 |
| 5 | Precipitation Flag | 546L*1 | 1-546 |
| 5 | Precipitation Trace Flag | 546L*1 | 547-1092 |
| 6 | Present/Past Weather Flag (Synoptic Time 1) | 546L*1 | 1-546 |
| 6 | " " " " " " 2 | 546L*1 | 547-1092 |
| 7 | " " " " " " 3 | 546L*1 | 1-546 |
| 7 | " " " " " " 4 | 546L*1 | 547-1092 |
| 8 | " " " " " " 5 | 546L*1 | 1-546 |
| 8 | " " " " " " 6 | 546L*1 | 547-1092 |
| 9 | " " " " " " 7 | 546L*1 | 1-546 |
| 9 | " " " " " " 8 | 546L*1 | 547-1092 |
| 10 | Number Reports During Day | 546L*1 | 1-546 |
| 10 | Number Reports Indicating Precipitation | 546L*1 | 547-1092 |

(Note: This layout is for the first reporting station of each Regional Daily Data File. The second reporting station of each file would reside in records 11 through 20. The number of records each of these files contains depends on the number of sites in that region; therefore, a region with 23 stations would require 230 records of size 1092 bytes.

NOAA Weather Data Base Building Procedure

When the weather data base is initially loaded on to the system, none of the data items will have any values. To fill the data base with information, NOAA must first decide what is the earliest date they wish to refer to. This date will then be defined as the base date. NOAA will then furnish LARS the weather data from the base date to the present. The Regional Daily Data Files will then be loaded with this weather data. The first value of each data item for all these files will contain data from the base date. The second data items will hold all data from the day after the base date. This loading process continues until the 546th day. Data from this day is loaded into the 546th or final position for all data items in the Regional Daily Data Files. The data base is then full; however, what is to be done with future data? The data base as designed in this outline calls for the writing-over of the oldest data with the most recently received data. For example, if LARS received 14 days worth of data from NOAA after the data base had been fully loaded, data from the base date and the following 13 days would be replaced by the new data. The base date would be incremented 14 days and the base date position would be 15. That is, the oldest data in the system will then be found in position 15 of all data items and the most recent data would be in position 14. This circular loading process continues as more data is received at LARS.

NOAA Weather Data Base File Structure

System File

| Data Item | Format | Bytes |
|----------------------|--------|-------|
| Region File Size | I*2 | 1-2 |
| Site File Size | I*2 | 3-4 |
| Base Date | I*4 | 5-8 |
| Base Date Position | I*2 | 9-10 |
| Number of attributes | L*1 | 11 |
| Unused | | 12-20 |

(Note: This file contains only one record)

NOAA Weather Data Base File Structure

Region File

| Data Item | Format | Bytes |
|-------------------------------|--------|-------|
| Region Name | 24A*1 | 1-24 |
| Region Number | I*4 | 25-28 |
| Regional Daily Data File Name | 8A*1 | 29-36 |
| Regional Daily Data File Size | I*2 | 37-38 |
| Pointer to First Reporting | | |
| Station in Site File | I*2 | 39-40 |
| Unused | | 41-50 |

Site File

| Data Item | Format | Bytes |
|-------------------------------------|--------|-------|
| WMO 5-digit Station Identifier | I*4 | 1-4 |
| 4 Character Airways Callsign | I*4 | 5-8 |
| Latitude of Station | I*4 | 9-12 |
| Longitude of Station | I*4 | 13-16 |
| Station Elevation | I*4 | 17-20 |
| Reporting Station Short Name | 10A*1 | 21-30 |
| Pointer to Region File | I*2 | 31-32 |
| Pointer to Regional Daily Data File | I*2 | 33-34 |
| Unused | | 35-50 |

APPENDIX F
FEBRUARY AND DECEMBER CMS SHORT COURSE OUTLINES

PURDUE/LARS SHORT COURSE OUTLINE

Presented at Johnson Space Center

February 5 - February 9, 1979

ORIGINAL PAGE IS
OF POOR QUALITYMONDAY

- 9:00 am I. Introduction (Susan Schwingendorf)
- A. Course Instructors
 - B. Consulting Team at LARS
 - C. Consulting Team at JSC
- II. Overview of LARS Computer System (Bill Shelley)
- A. Hardware (capacities)
 - B. Operating System
 - C. Accessing the Computer
 - IDs, passwords and Beginning CP Commands
 - (Logon, Logoff, Ipl, Query, Begin, SPOOL, REMOTE, DETach,
 - PURge, DISC, IND, MSG)
- 10:30 III. CMS370 Editor (Luke Kraemer)
- LUNCH
- 1:30 IV. Beginning CMS370 Commands (Susan Schwingendorf)
- (Listfile, Type, PRINT, PUNCH, READcard, GETDISK, Query,
 - COPYfile, Rename, ERASE, RELease, TAPMOUNT, TAPE)
- V. "Hands-on" for Editor and CMS370 Commands
- At least one instructor will go to LARS terminal area
 - Other instructors may go to other areas of the building
 - at the request of course participants.

TUESDAY

"Hands-On" (continued)

- 9:00 am VI. CMS370 Commands (Part II) (Susan Schwingendorf)
- (Query, SET, Listfile, STATE, COMPare, COPYfile, SORT, TAPE,
 - BACKUP, MOVEfile, DISK, SYNONYM)
- 10:30 VII. Algorithm Implementation (Writing & Testing Programs) (Bill Shelley)
- A. Efficient Programming Practices
 - B. Commands to Create, Modify and Move Data Files & Programs (Review)
 - C. Compiling Your Program
 - D. Commands to Develop and Test Programs
 - E. Debug Commands
- LUNCH
- 1:30 VIII. Beginning EXEC File Creation (Luke Kraemer)
- IX. "Hands-On" for CMS370. Running Programs and EXECs

**Purdue/LARS CMS Short Course Schedule
December, 1979**

| | | <u>Level</u> |
|------------------|--|-----------------|
| <u>MONDAY</u> | 8:30 Introduction to VM370 | (Introductory) |
| December 10 | 9:00 HANDS-On | |
| | 10:00 CMS I | (Introductory) |
| | 11:00 HANDS-ON | |
| | ----- | |
| | 1:30 Virtual Machine Concepts | (Intermediate): |
| | 2:30 CMS II | " |
| | 3:30 HANDS-ON | |
| <u>TUESDAY</u> | 8:30 EDIT I | (Intermediate) |
| December 11 | 9:30 EXEC I | " |
| | 10:30 HANDS-ON | |
| | ----- | |
| | 1:30 Programming I | (Intermediate) |
| | 2:30 Batch I | " |
| | 3:30 HANDS-ON | |
| <u>WEDNESDAY</u> | 8:30 Programming II | (Experienced) |
| December 12 | 9:30 Stat Packages | (Intermediate) |
| | 10:30 RT&E Data Bases | " |
| | 10:30 HANDS-ON | |
| | ----- | |
| | 1:30 CMS III | (Experienced) |
| | 2:30 CP Commands | " |
| | 3:30 Other RT&E Software (IMSL, CSMP, LARSYSPl,...) | (Intermediate) |
| | 3:30 HANDS-ON | |
| <u>THURSDAY</u> | 8:30 EXEC II | (Experienced) |
| December 13 | 9:30 Batch II | " |
| | 10:30 EDIT II (Macros) | " |
| | 10:30 HANDS-On | |
| | ----- | |
| | 1:30 Graphics Programming | (Intermediate) |
| | 2:30 LARSPEC | " |
| | 4:00 HANDS-ON | |
| <u>FRIDAY</u> | 9:00 Script | (Intermediate) |
| December 14 | 9:00 and 11:00 LARSPEC Demonstration | |
| | 9:00 - 2:00 pm General Consulting in the Remote Terminal Area | (Everyone) |